XI N 4 APRIL, 1950

THE TOOL ENGINEER

REG. U.S. TRADE MARK

AL PUBLICATION: AMERICAN ASTE SOCIETY OF TOOL ENGINEERS

This Show Edition of *The Tool Engineer* contains your complete Program and Exhibit Guide for the 1950 ASTE Convention and Industrial (Cost-Cutting) Exposition. It comprises a valuable permanent addition to your library.

To the many tool engineers, exhibitors and advertisers who are joining in a cooperative effort to cut manufacturing costs, this issue of *The Tool Engineer* is respectfully dedicated.

American Society of Tool Engineers

A TE Exposition Edition

Price $2.50

Behind every manufactured product is the tool engineer

The Tool Engineer

Official Publication: American Society of Tool Engineers

Member: Audit Bureau of Circulation

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April, 1950

Vol. XXIV No. 4

Editorial

Cost-Cutting and the Tool Engineer

THIS is written as more than 30,000 cost-minded executives are preparing to converge on Philadelphia to see and hear about the latest in methods and machines for cutting costs.

The attendance at ASTE's Cost-Cutting Exposition, the huge number of manufacturers who will exhibit are an overwhelming testimony to the importance of tool engineering and the fields it serves.

At present, with high costs both of labor and materials, to say nothing of taxes, transportation and many other factors, emphasis on reducing manufacturing costs has achieved considerable popularity. The history of the tool engineer, way back through the ages, shows that cost-cutting has always been a primary function of his work.

Cost-cutting is an integral part of manufacturing and selling, because never is there justification for higher-than-necessary costs in production, administration or sales.

Therefore the tool engineer is not partaking in a sporadic attempt to trim figures a bit. He is arming with new methods and machines for a new and more important phase of his continuing battle—a phase that is made more significant by the current need for larger markets which will absorb more goods and consequently maintain our economy at its present high level.

Over 300 exhibitors are cooperating in this giant engineering forum; more than 20 technical speakers will describe practical operating methods. The 30,000 tool engineers and guests who will carry this material back home with them will most certainly be in an advantageous position to approach problems with a better background and keener insight.

R. B. Douglas

President 1949-1950

THE TOOL ENGINEER is published monthly in the interest of the members of the American Society of Tool Engineers. Entered as second class matter, November 4, 1947, at the post office at Milwaukee, Wisconsin, under the Act of March 3, 1879. Yearly subscription, $2.00. Non-members, $6.00. Canada, $6.50; all other foreign countries, $8.00 per year.

OFFICE OF PUBLICATION (printing) 239 E. Chicago St., Milwaukee, Wis. ADDRESS ALL CORRESPONDENCE TO: EDITORIAL AND ADVERTISING OFFICES: 10700 Puritan Ave., Detroit 21, Michigan.

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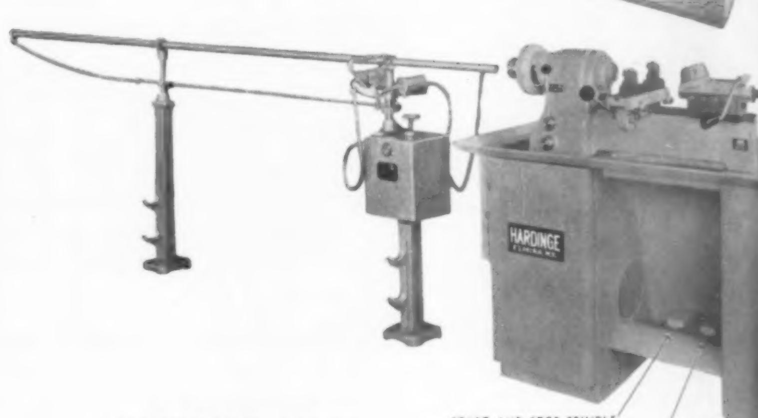

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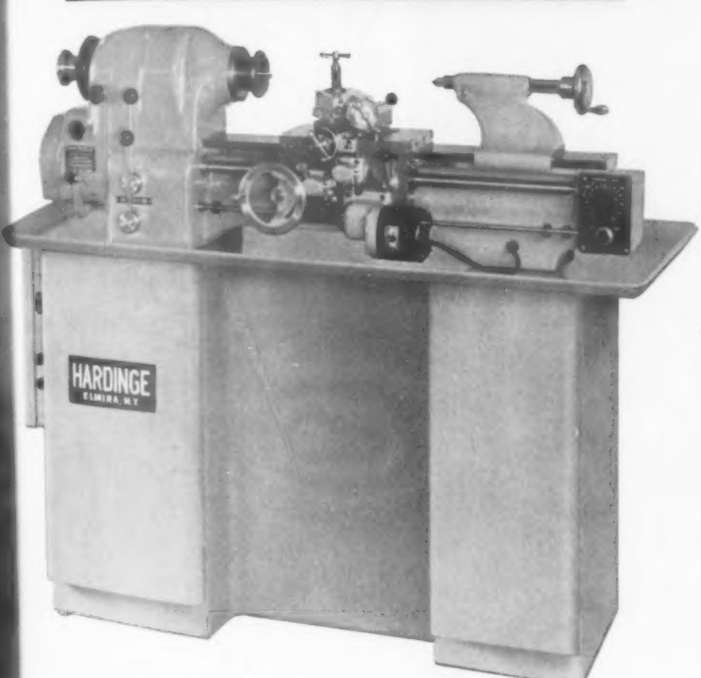

HARDINGE HL Tool Room Lathe

HARDINGE DV59 Lathe

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[HAR]DINGE-SJOGREN [SP]EED COLLET CHUCK

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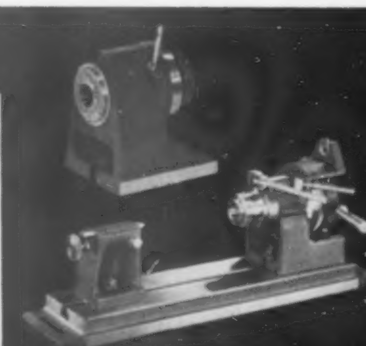

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cut threads

BETTER
FASTER
CHEAPER

1. LANDIS DIE HEADS cut tool cost by using chasers that are independent units. Worn or damaged chasers are reground or replaced *individually,* without affecting the remaining chasers of the set.

2. LANDIS DIE HEADS reduce tool inventories by cutting *both* right- and left-hand threads with a *single* set of chasers. Chasers are ground on both ends, the spring action in the die head is reversed, and either a right-hand or left-hand set of chaser holders is used.

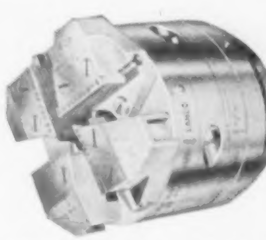
3. LANDIS DIE HEADS cut all diameter threads with a constant pitch and form within the rated range of the die head with a *single* set of chasers. Short thread lengths larger than the rated diametrical range can be cut with the *same* die head equipped with over-size chaser holders.

4. LANDIS DIE HEADS use chasers that can be reground to 80% of their length. Regrinding is a simple operation restoring the entire cutting edge and leading feature, yet retaining the initial accuracy of pitch, diameter, and depth of cut.

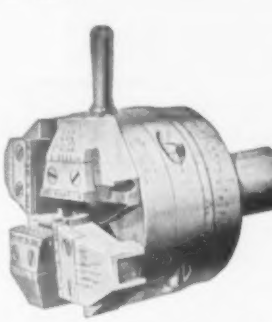
5. LANDIS DIE HEADS improve thread finish and cut production costs by reducing chaser wear and breakage. The tangential position of the chaser to the work allows lateral absorption of cutting strains. Resulting reduced friction and vibration make higher cutting speeds possible without causing thread distortion or chaser breakage.

6. LANDIS DIE HEADS consistently produce threads accurate for lead. Regrinding does not destroy the lead controlling feature of the chasers. Thus this feature assures accurate pitch threads throughout the chaser's life.

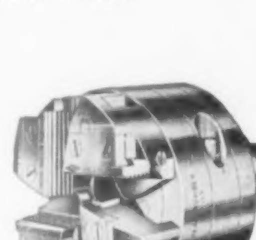
7. LANDIS DIE HEADS are built to stay on the production line. Tough, high-carbon steel is used in all parts. Rigid construction maintains accuracy, and minimizes wear of working parts. Landis Die Heads are furnished in two models, heat-treated or hardened-and-ground, depending on the application and quality of thread desired.



LANCO—a revolving die hand for hand-operated, semi-automatic, and automatic threading machines.



LANDMATIC—a stationary die head with self-opening action for turret lathes.



LANDEX—a revolving die head for automatic screw machines and other "live spindle" machines.

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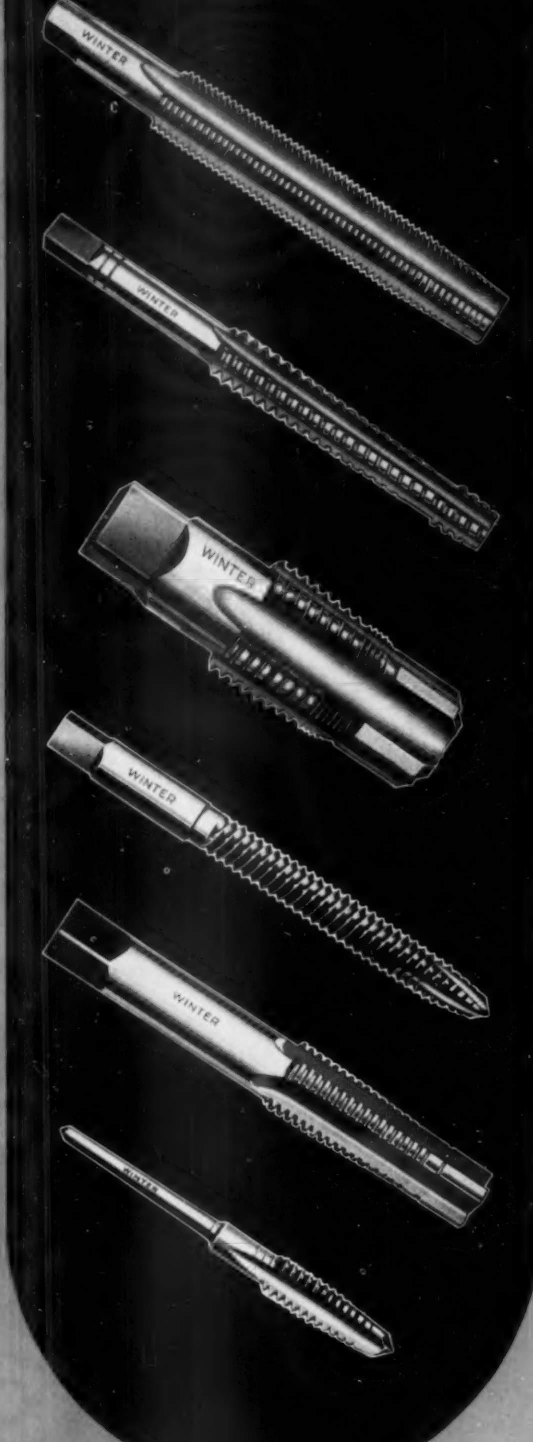

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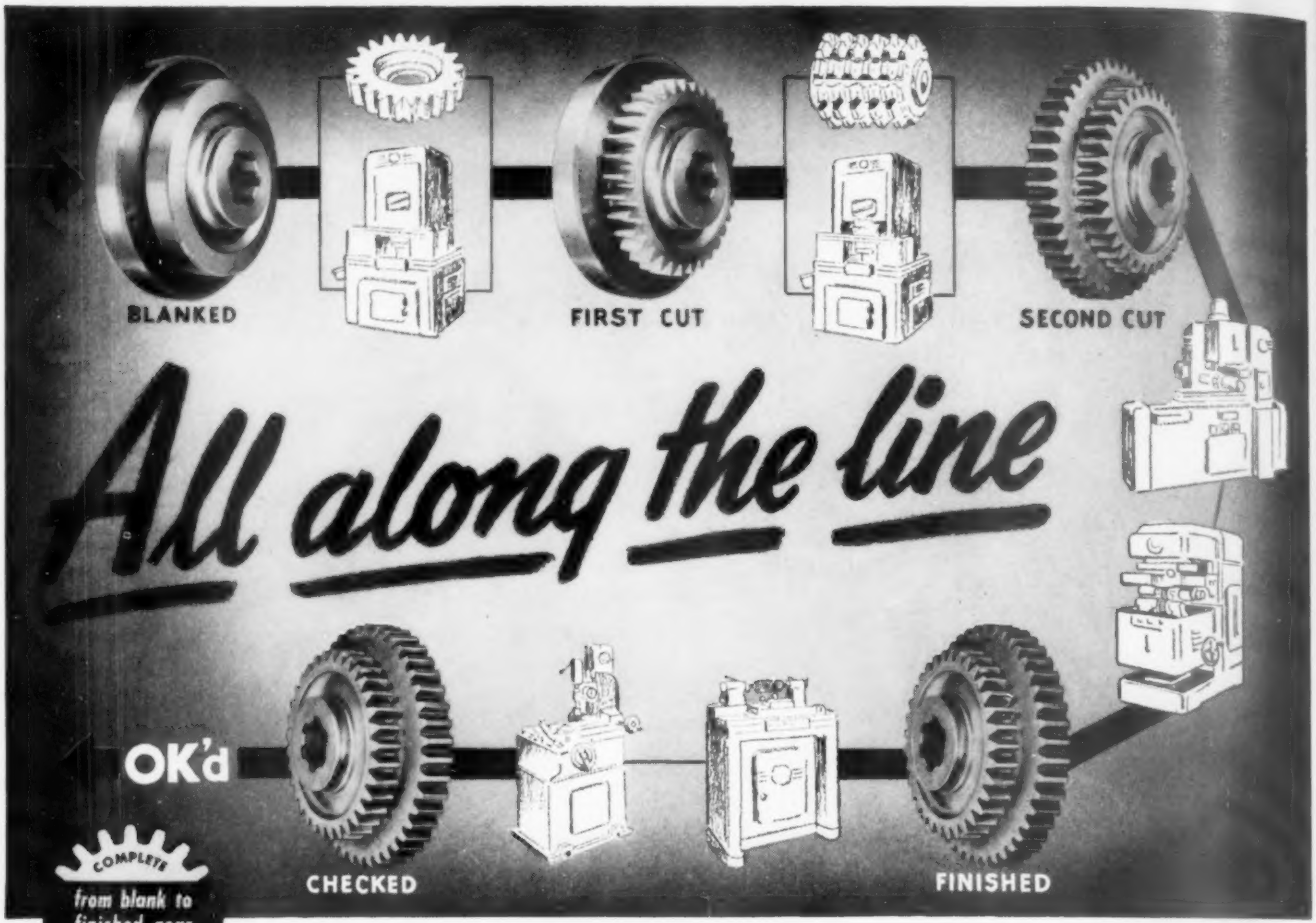

COMPLETE
from blank to finished gear
EQUIPMENT

We're in the business of cutting gear costs—ALL ALONG THE LINE
. . . with machines, with tools
. . . and WITH SOMETHING ELSE.

Sure we make all types of hobs, shaper cutters and miscellaneous gear tools; gear finishing machines (10 different models) for every kind and size of spur and helical internal and external gear. Sure we developed pre-shave hobs and cutters, Sine-Line gear and hob checkers (13 machines) plus Shear-Speed machines (4 sizes) to cut gears as fast as they can be finished.

But that's only part of the story. Tools and machines are like ingredients in a good stew. Each must be good, but you must also mix them correctly.

When you do:

. . . you can frequently HOB AND SHAVE a gear in LESS TIME than it takes just to hob it. You can also wind up with a lower TOTAL tool cost.

. . . you can cut total tool-change down-time with machines on which you change tools *more* often.

Crazy? Not on your involute.

. . . you can reduce cost of gear cutting by making a change in a *different* operation.

. . . you might get *more* output by *cutting* capital investment in new equipment by 80%.

. . . a different cutter width could easily cut shaving time in half.

Would you like to get your gear cutting tools "for nothing"?

. . . savings in re-grinding time can more than pay for the tools.

. . . raising your gear checking costs could cut over-all gear costs.

Impossible? They've all been done—many, time and again—by Michigan Tool engineers while cutting gear costs ALL ALONG THE LINE for somebody.

How much can we cut yours? Let's find out. Give us a ring or drop us a line.

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EQUIPMENT

MICHIGAN TOOL COMPANY

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Indicate A-4-8-1

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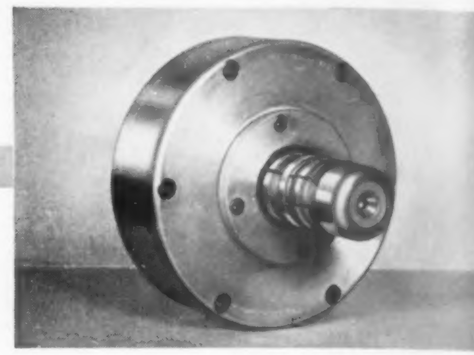
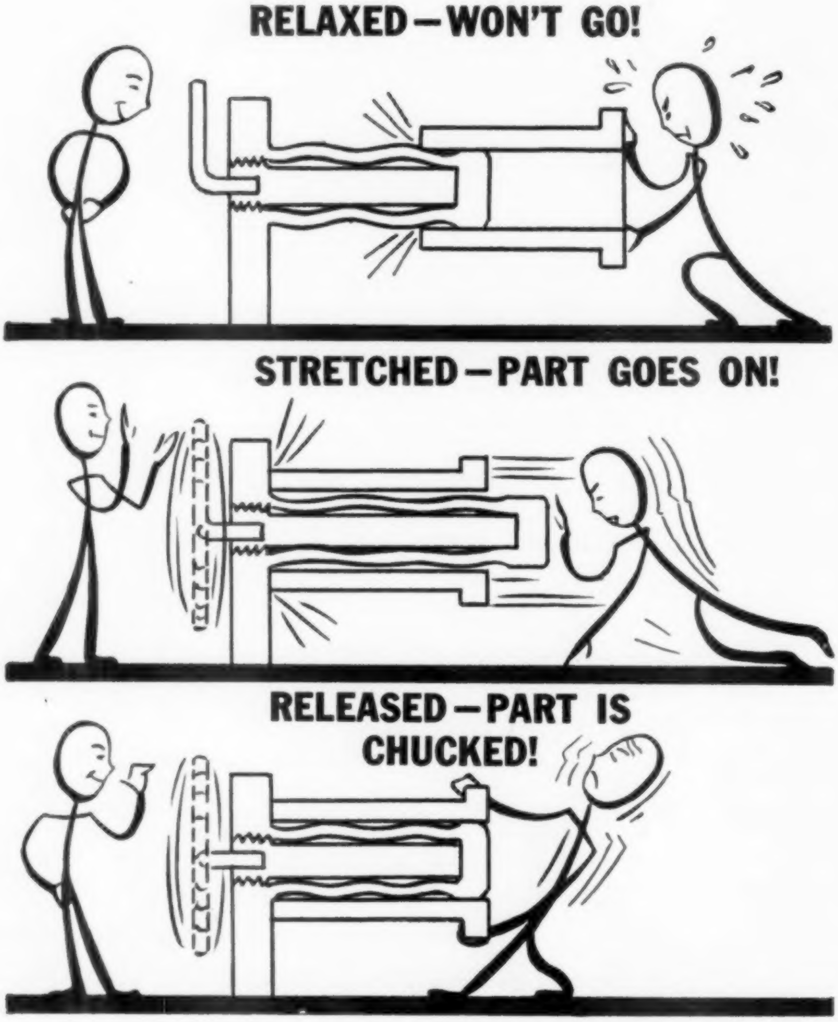


THE N. A. WOODWORTH DIAPHRAGM ARBOR



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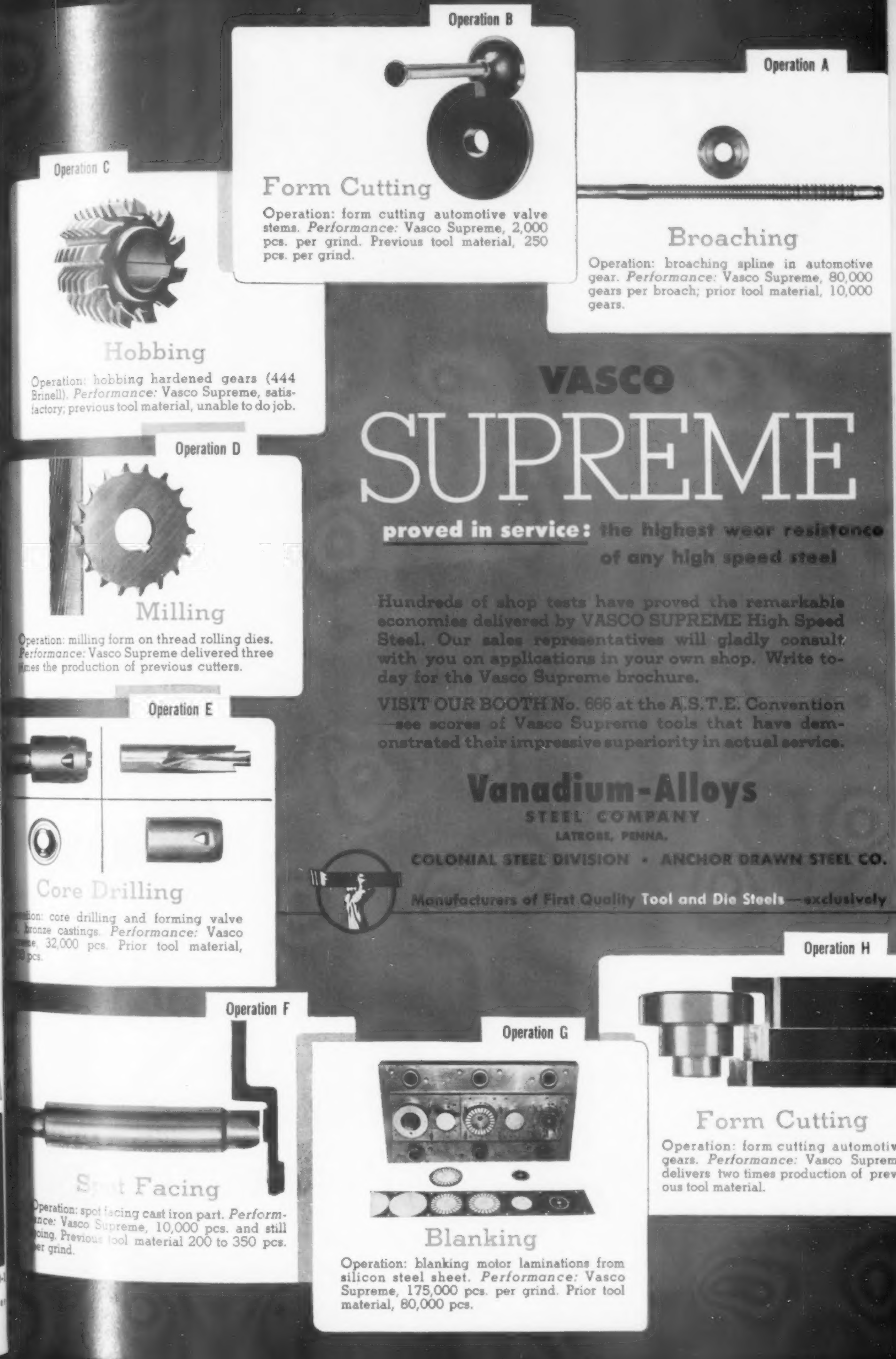
Operation A
Broaching
Operation: broaching spline in automotive gear. Performance: Vasco Supreme, 80,000 gears per broach; prior tool material, 10,000 gears.
Operation B
Form Cutting
Operation: form cutting automotive valve stems. Performance: Vasco Supreme, 2,000 pcs. per grind. Previous tool material, 250 pcs. per grind.
Operation C
Hobbing
Operation: hobbing hardened gears (444 Brinell). Performance: Vasco Supreme, satisfactory; previous tool material, unable to do job.
Operation D
Milling
Operation: milling form on thread rolling dies. Performance: Vasco Supreme delivered three times the production of previous cutters.
Operation E
Core Drilling
tion: core drilling and forming valve bronze castings. Performance: Vasco me, 32,000 pcs. Prior tool material, pcs.
Operation F
Spot Facing
peration: spot facing cast iron part. Performance: Vasco Supreme, 10,000 pcs. and still going. Previous tool material 200 to 350 pcs. per grind.
Operation G
Blanking
Operation: blanking motor laminations from silicon steel sheet. Performance: Vasco Supreme, 175,000 pcs. per grind. Prior tool material, 80,000 pcs.
Operation H
Form Cutting
Operation: form cutting automotive gears. Performance: Vasco Supreme delivers two times production of previous tool material.
VASCO
SUPREME
proved in service: the highest wear resistance of any high speed steel
Hundreds of shop tests have proved the remarkable economies delivered by VASCO SUPREME High Speed Steel. Our sales representatives will gladly consult with you on applications in your own shop. Write today for the Vasco Supreme brochure.
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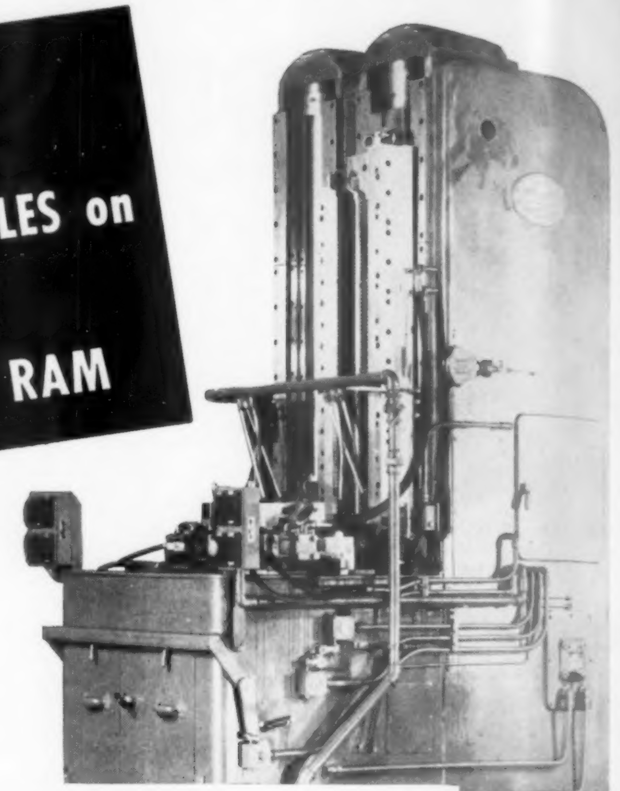
Broaching WHEEL SPINDLES on *American* DUAL RAM



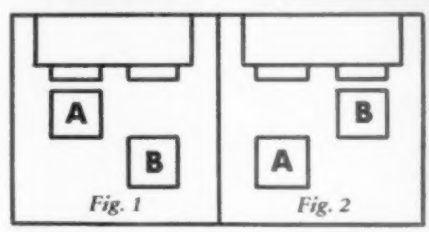
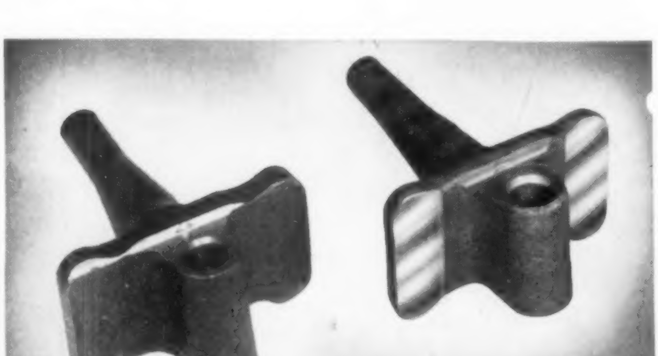


Fig. 1 *Fig. 2*

Straddle broaching the flange faces and the stem end of automotive wheel spindles in one pass was a broaching operation easily adapted to the American Dual Ram Surface Broaching Machine.

The combination of broaching the flange faces and stem end in one pass was possible because of the wide machine slides which are a standard feature on American machines. The part was manually located sideways on the fixture which was provided with a hydraulically interlocked clamp. As the broach assembly was duplicated on each ram and the fixture on each table, one part was broached complete in one pass at each station. This provided a high production rate for these wheel spindles, which are shown before and after broaching in the illustration below.



On the diagram above figures (1) and (2) illustrate the opening cycle of the receding type tables.

In figure (1) table (A) is in broaching position and table (B) is in unload and load position. In figure (2) the tables are reversed and the operator unloads and loads the fixture on table (A) while (B) is in broaching position.

All moving parts of the machine are electrically interlocked as a safety precaution for the operator and the tooling. The machine cycle can be arranged for semi-automatic operation whereby the operator starts each cycle or if the loading time does not exceed the broaching time continuous automatic cycle can be used.

American manufactures a complete line of hydraulic broaching machines for surface and internal operation.

If you have a metal removing operation send a blue print of the part with the required dimensions and hourly production. American engineers will recommend the machine and tooling for the operation without obligation.

Write for free literature Circular 300 covering American's complete line of hydraulic surface broaching machines.

AMERICAN

***American* BROACH & MACHINE CO.**

A DIVISION OF SUNDSTRAND MACHINE TOOL CO.

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SUNDSTRAND MACHINE TOOL CO. ROCKFORD ILLINOIS

See *American* First — for the Best in Broaching Tools, Broaching Machines, Special Machinery

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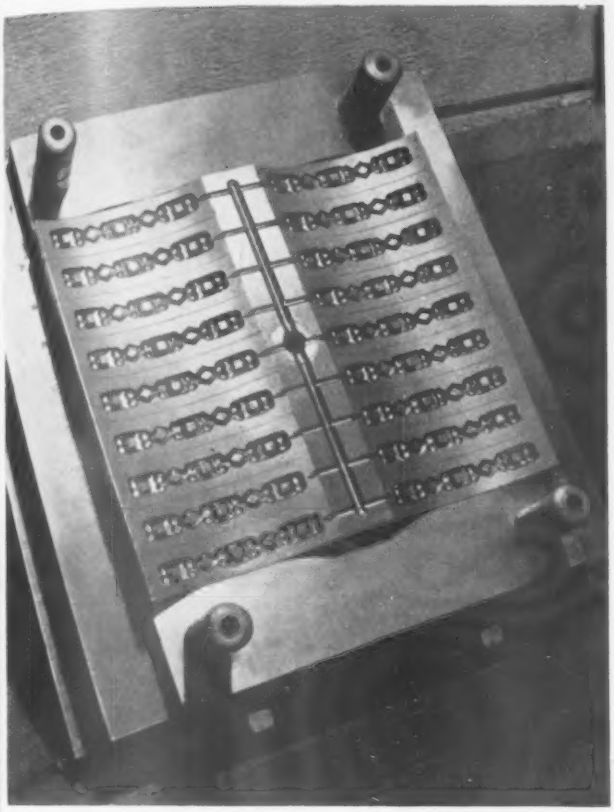
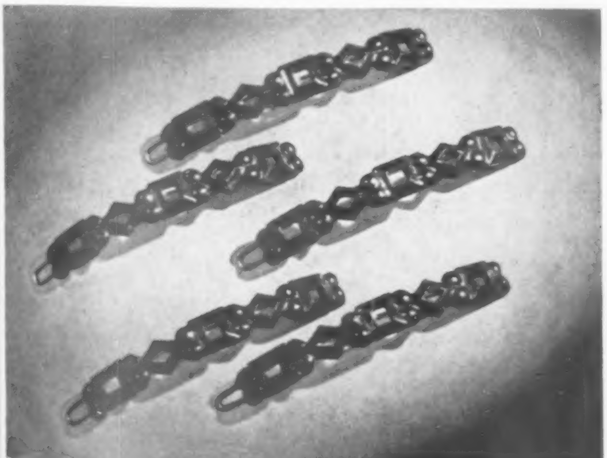
DURAMOLD A

Air-Hardening Hobbing Steel for Mold Cavities



Hobbed from Duramold A in one push, this mold is a fine example of the intricate detail which can be attained in hobbing. The square and diamond-shaped "core pins" were raised up in the mold by the pressure of the master hob. Movement in heat-treatment was held to a minimum.



The highly polished surfaces of the mold made possible a high-quality finish on these injection-molded plastic barrettes. Mold made by Banner Mold & Die Co., Inc., Leominster, Mass. Plastic molding by E. B. Kingman Co., Leominster, Mass.

Duramold A has outstanding advantages for mold cavities used in the plastics industry. It's easy to hob . . . and its 5 pct chromium content provides high wear-resistance and core strength. Distortion in hardening is minimized by its air-hardening characteristics.

Duramold A has the balanced alloy content that meets today's requirements for a hobbing steel with high mechanical properties. Here are the facts:

High Wear-Resistance. Duramold A is suitable for long runs because of its alloy content and high surface-hardness after carburizing (Rockwell C—61 to 63).

Holds Close Dimensions. Air-hardening greatly reduces distortion in hardening, making Duramold A suitable for intricate cavities, thin sections.

Easy to Hob. It anneals to less than 109 Brinell and hobs deeper than the nickel-chromium steels. It does not work-harden rapidly.

Takes High Polish. Duramold A is scrupulously inspected to assure a clean, sound structure. The 5 pct chromium content provides improved corrosion-resistance, as compared with ordinary hobbing steels.

For High Temperatures and Pressures. It is suitable for operating temperatures up to 650 F. Its high core strength permits high pressures.

High Surface Hardness. An air-cool, following carburizing at 1700 F and a 300 to 400 F temper, results in a surface hardness of Rockwell C—61 to 63. Core hardnesses are in the range of Rockwell C—30.

For Machined Cavities. When Duramold A is used for a machined cavity, it is annealed at 1600 F to obtain a Brinell hardness of 170 . . . which machines easily.

Typical Analysis	C	Mn	Si	Cr	Mo
	0.07 max	0.40	0.20	4.50	0.45

The nearest Bethlehem sales office or tool-steel distributor will gladly tell you about this hobbing steel and other Bethlehem Tool Steels for both hobbed and machined cavity molds. Write today for our new booklet, "Tool Steels for the Plastics Industry."

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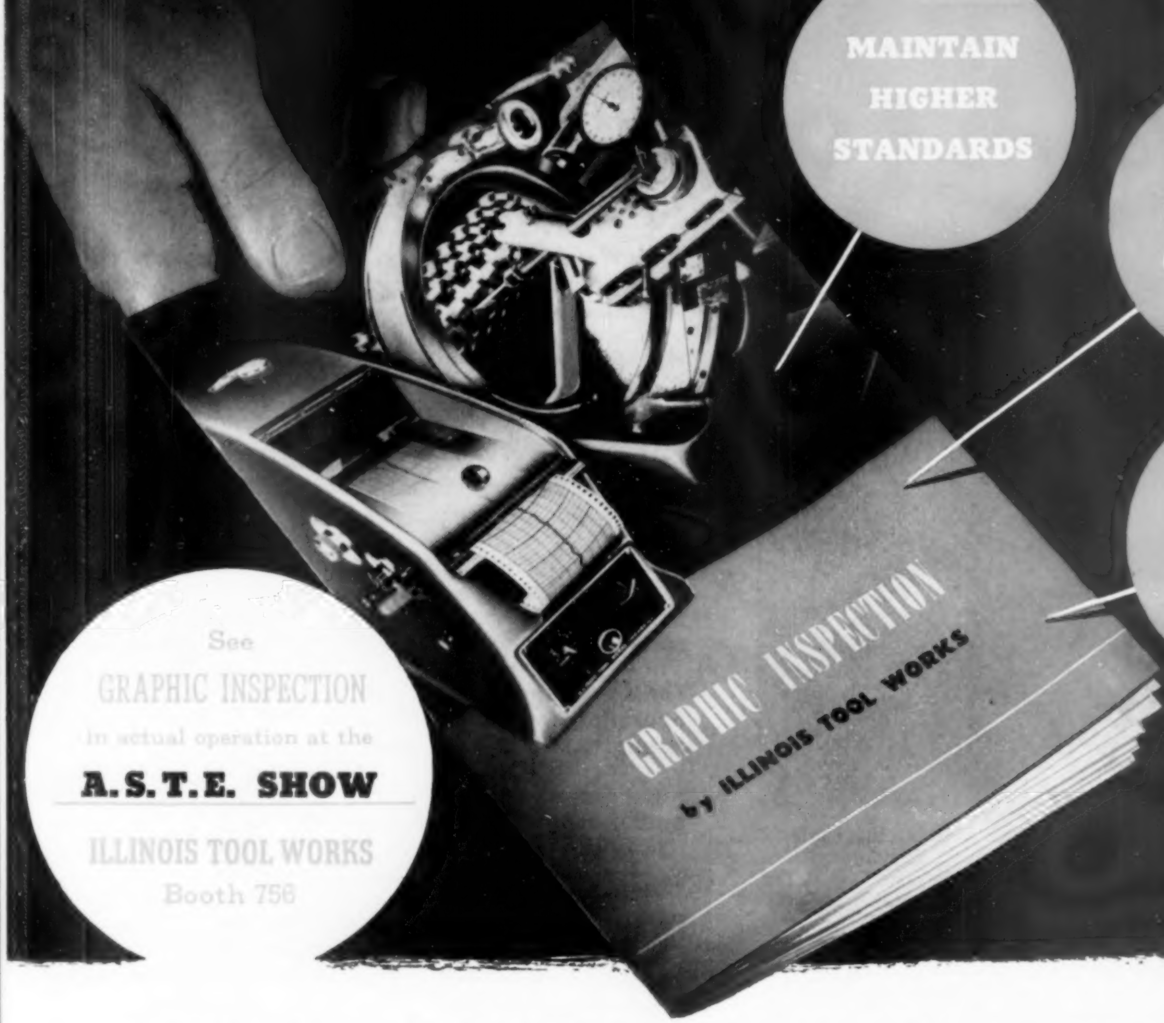

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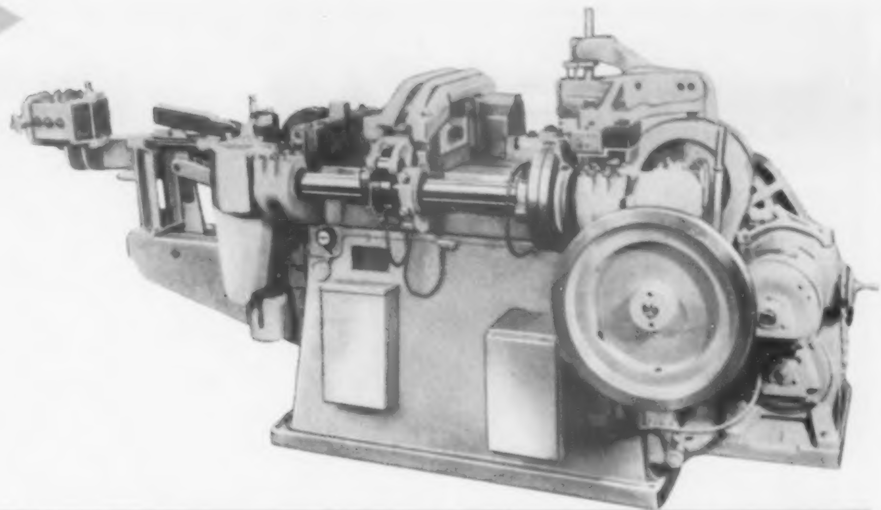
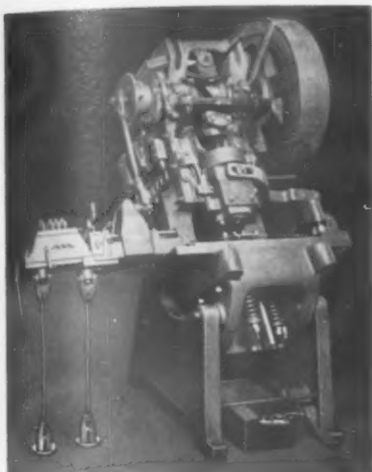
Can accommodate material up to 2" in width, and provide a feed length adjustable up to a maximum of 12" at each stroke. Precision formed stampings involving piercing, trimming, swaging, embossing, blanking and forming can be produced complete in the machine. Three other sizes of U.S. Multi-Slides are also manufactured.





COST-CUTTING PRODUCTION EQUIPMENT BY U. S. TOOL

U. S. Multi-Slide Machines are designed and built for the automatic high speed production of precision formed stampings from coil stock. Complete specifications are contained in Bulletin #15. **U. S. Automatic Press Room Equipment** includes U. S. Slide Feeds, Roll Feeds, Plain and Power-Driven Straighteners, Plain and Power-Driven Stock Reels, Plain and Power Driven Coil Cradles, Stock Oilers and Wipers. Bulletin #70 gives complete specifications. **U. S. Multi-Millers** are production milling machines for performing a wide range of operations on small and medium-sized parts. Specifications are contained in our General Catalog. Ask for a copy.

Left—Top to Bottom:

U. S. Slide Feed with U. S. Plain Straightener mounted in conventional manner on open back inclinable punch press, converting the press into an automatic machine. U. S. Slide Feed controls the pitch between definite stops, and can pull material through a plain straightener and maintain controlled accuracy. U. S. Slide Feeds and Straighteners made in a range of sizes.

U. S. Power-Driven Straightener, suitable for material up to 18" in width by ⅛" thick, depending on type and temper of material. Arranged with variable speed drive, mercury switch control, and motor. Made in a range of sizes.

AR-1 U. S. Automatic Vertical Type Stock Reel, suitable for material up to 5¼" and coils weighing up to 400 pounds. Furnished with quick clamping forks, mercury switch control and motor. Can be arranged either for unwinding or rewinding. U. S. Automatic Stock Reels of similar type are made in a wide range of sizes.

U. S. Multi-Miller (above)

U. S. Multi-Miller, designed and built for production milling operations on small and medium-sized parts. Table feed is cam-controlled, allowing for fast approach to cut, cut at required speed, and fast return. Made in a number of types and sizes.

U. S. TOOL COMPANY, Inc.

Ampere (East Orange) New Jersey

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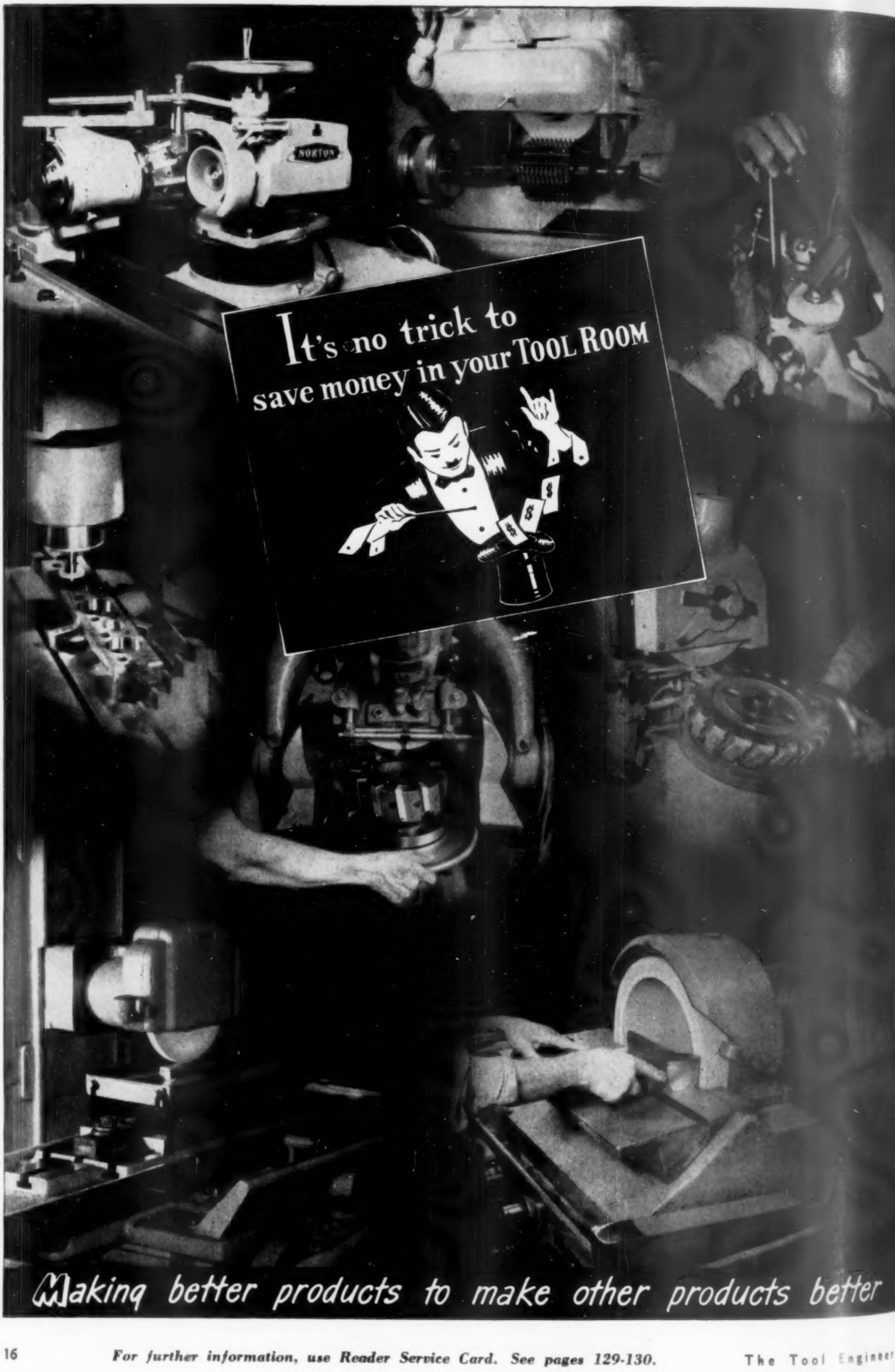
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Making better products to make other products better

You'll Find It Really Easy with 32 ALUNDUM Grinding Wheels

And Here's Why . . .

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In plant after plant they are finding that the extra sharpness of 32 ALUNDUM wheels and their greater number of cutting points enable them to remove stock from high speed steel and cast alloy tools at rates from four to six times faster per pass than with other abrasives. That means a big saving in tool grinding costs.

Less Dressing

And "32" wheels stay sharp longer. That's because there are more cutting points doing the work and points that don't dull quickly because they are over 99% pure fused alumina. You can go all the way around even a large multi-tooth cutter without having to stop and dress a 32 ALUNDUM wheel. This is another big cost saver.

Less Tool Spoilage

"32" wheels cut so cool that there's far less spoilage of heat-sensitive high speed steels—even with inexperienced operators. That's because grinding heat is spread over more cutting points and points that are sharper, that penetrate high speed steels more easily.

There's Also "38" and "57"

Some of your tool grinding jobs may be such that "32" is not the recommended abrasive but you can be sure that there is a Norton abrasive with just the right characteristics to give you maximum economy. It may be 38 ALUNDUM abrasive, the original white abrasive and a tool room favorite for 40 years. Or it may be 57 ALUNDUM abrasive which combines a fast cutting action with great toughness and thus is widely used for off-hand tool grinding operations. And these are still further supplemented by regular ALUNDUM wheels and 19 ALUNDUM wheels.

AT PHILADELPHIA . . .

See for yourself the fast, cool cutting action of "32" wheels. Watch them in action at Norton Space 409 at the TOOL ENGINEERS INDUSTRIAL EXPOSITION.

NORTON
ABRASIVES

NORTON COMPANY, WORCESTER 6, MASS. · Warehouses in Five Cities · Distributors in All Principal Cities

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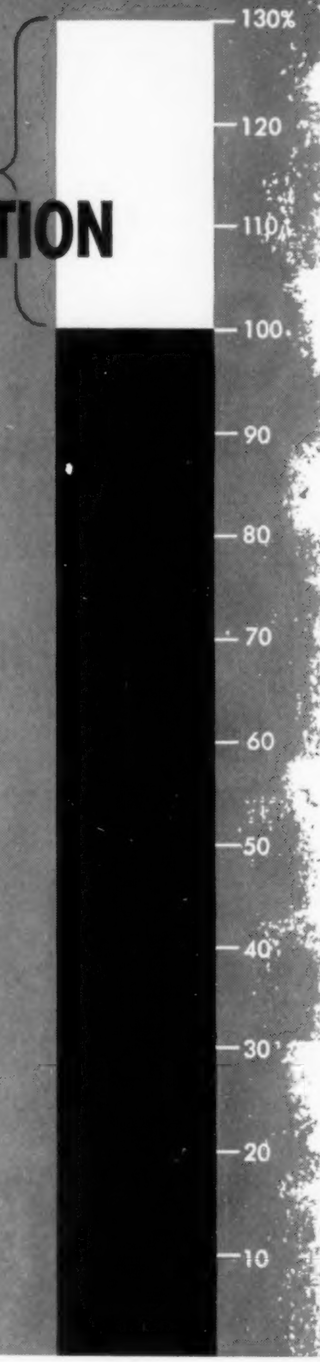
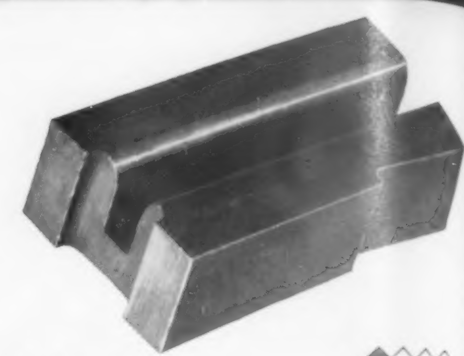
are you sure you can't get

BONUS PRODUCTION

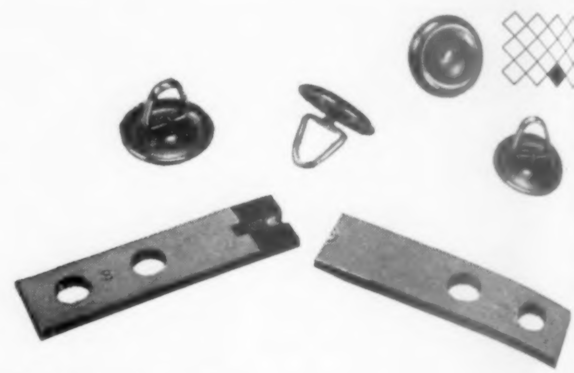
from your tools and dies ?





Output Per Grind Up 300%
—A Real Bonus in Tool Performance

Nobody was complaining about production per grind from this punch—the main problem was breakage at the corners. The Tool Room Foreman used the Carpenter Matched Set Method to select the one steel ideally suited to the job. Now, with No. 610 (Air-Wear), breakage has not only been eliminated, *but the Company has increased production per grind by 300%.* It really pays to be dissatisfied with "Expected Production".



110% Production Bonus
—Because "Expected Production" Wasn't Good Enough

These gripper blades for producing mattress buttons were running along "O.K." . . . production was good. But the Tool Engineer figured he could do better. And here's what happened: After selecting SOLAR (Water-Tough) from the Matched Set, production per pair of blades soared over 110%. Further, the plant now uses SOLAR for all blades in a battery of 12 machines.

Today, with everyone demanding that costs be cut to the bone, why be satisfied to string along with "Expected Production"? It will certainly pay you to give the tried and proved Carpenter Matched Set Method a try. And honestly, you'll be surprised at how easy it is to put to work. For one of its biggest advantages is the *simplification* it gives you—simplification of selection, heat treatment, and inventories. Prove it yourself—it's easy. Simply pick out a job—put the Matched Set Method to work—then compare results!

Export Department, 233 Broadway, New York 7, N. Y. "CARSTEELCO"

—And you can get IMMEDIATE DELIVERY from LARGE STOCKS

The Standard Tool Steels of Industry

Carpenter

MATCHED TOOL & DIE STEELS

Offices and Warehouses in Principal Cities Throughout the U.S.A. and Canada

THE CARPENTER STEEL COMPANY, 154 W. Bern St., Reading, Pa.

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SLIDE RULE

For Cost Estimating, Machine Loading and Subcontract Pricing with

WALES FABRICATORS

Wales Fabricator starts producing parts immediately from drawings ...NO TEMPLETS REQUIRED.

• Now, you can figure the time and cost of each part and complete run on a Wales Fabricator whether the part is in the engineering, planning or production stage.

There is nothing like this revolutionary Wales Fabricator. It punches, notches and nibbles. Wales exclusive Hydra-New-Matic Drive is unique in its simplicity of design and operation . . . so unique, in fact, the vibration and noise is practically elminated at 165 strokes a minute. This drive, plus Wales patented "Quick-Change" System makes possible startling "never-heard-of-before" cost savings.

Write for your FREE Slide Rule TODAY and compare THE WALES METHODS *with your present operations.*

WALES-STRIPPIT CORPORATION
George F. Wales, Chairman
393 PAYNE AVENUE, NORTH TONAWANDA, N. Y.
(Between Buffalo and Niagara Falls)
Wales-Strippit of Canada Ltd., Hamilton, Ontario

Specialists in Punching and Notching Equipment

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The COMBINATION THAT CLICK
BEHR-MANNING
BEHR
USE
NORTON

for maximum finishing profits
1. THE RIGHT BEHR-MANNING CONTACT WHEEL
Many to choose from—large, small, hard and soft. It's the right contact wheel that can make the difference between ordinary results and higher production benefits, lower cost and more uniform finishes.
2. THE RIGHT BEHR-MANNING ABRASIVE BELT
These are the belts that cut sharp longer and give you more speed and economy with the kind of finish your work demands. LIGHTNING® METALITE® Cloth Belts for most polishing jobs, RESINALL® METALITE Cloth Belts for tougher stock removal grinding, team up perfectly with the right contact wheels for real finishing profits.
3. THE RIGHT ENGINEERING SERVICE "PAYS OFF"
An experienced Behr-Manning field engineer specifies the right belt method and equipment. Local Methods and Demonstration Rooms are available to you at our branches in 16 key industrial cities. And there's the Behr-Manning engineering research laboratory with more than 150 abrasive technicians and engineers insuring you of the latest developments.
NEW BROCHURE ON BELT FINISHING
Here is the latest on backstand belt grinding and polishing. It's full of illustrations and technical data and it's free for the asking. Just fill in the coupon and mail it today.
Why thousands of shops have switched
...to backstand grinding and polishing with BEHR-MANNING METALITE Cloth Belts
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TROY, N.Y.
RTON
brasives SHARPENING STONES
BEHR-MANNING, TROY, N. Y. DEPT. MG-250
Please send my copy of your new Backstand Brochure.
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Company
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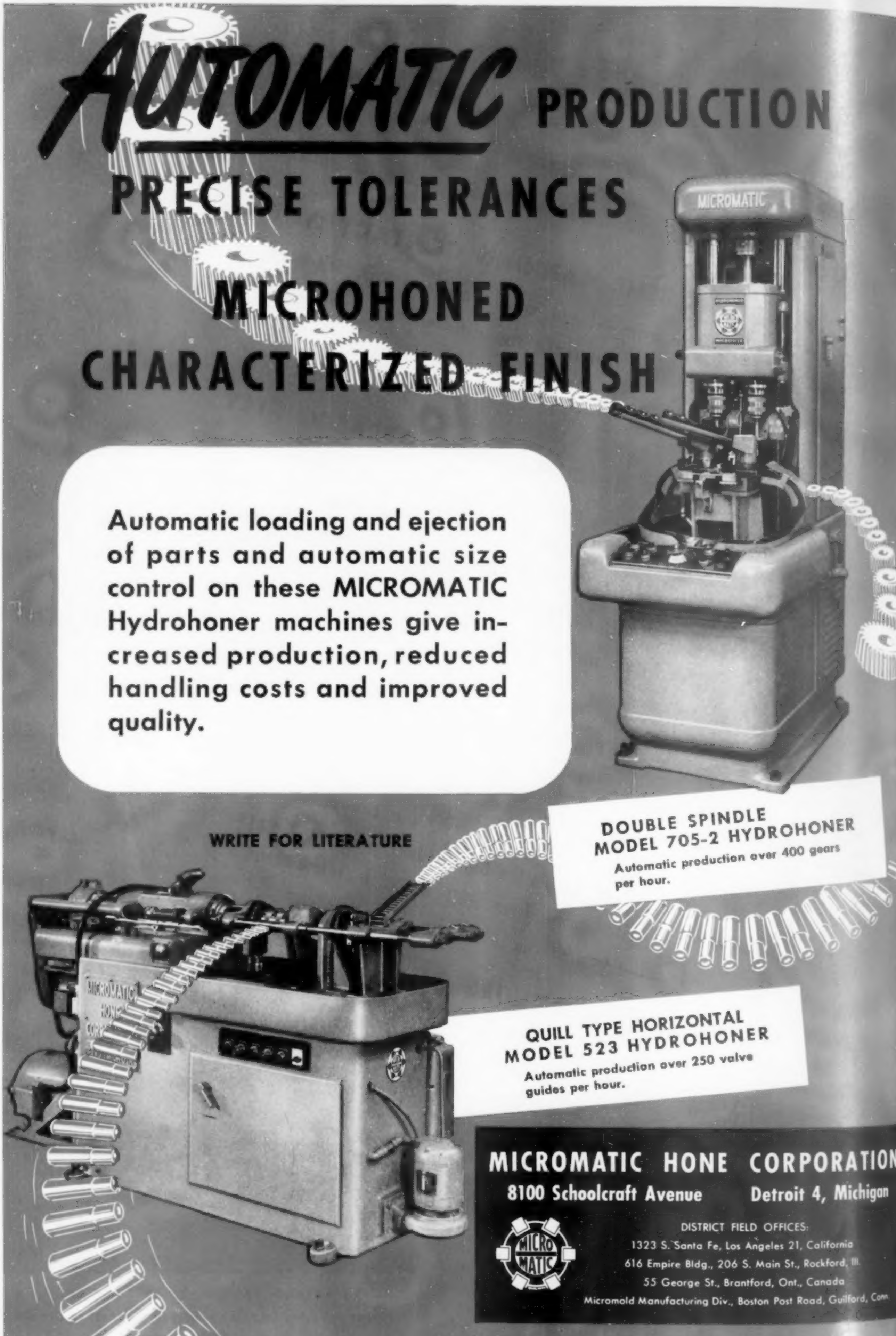
AUTOMATIC PRODUCTION
PRECISE TOLERANCES
MICROHONED
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Automatic loading and ejection of parts and automatic size control on these MICROMATIC Hydrohoner machines give increased production, reduced handling costs and improved quality.
WRITE FOR LITERATURE
DOUBLE SPINDLE
MODEL 705-2 HYDROHONER
Automatic production over 400 gears per hour.
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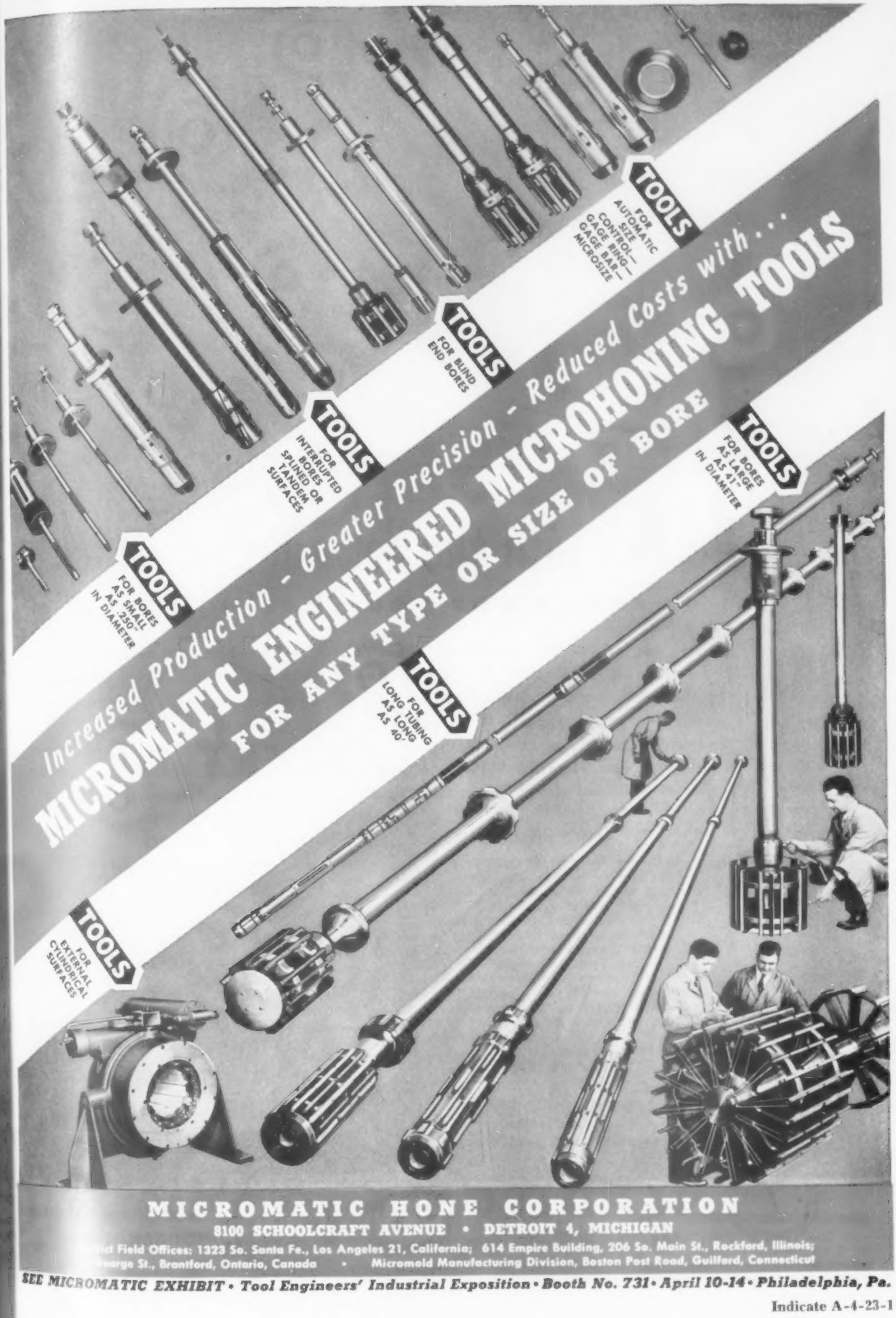

SEE MICROMATIC EXHIBIT • Tool Engineers' Industrial Exposition • Booth No. 731 • April 10-14 • Philadelphia, Pa.

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The Men with the Holes in their Heads!

can lower your boring costs

Big holes! Little holes! Deep holes! How can we bore 'em better for less? This may be your problem occasionally. But boring holes at lower cost is the full time problem for Madison engineers. This specialization can save *you* money just as it is doing every day for leading manufacturers. Why not take advantage of the two big things — Madison experience and Madison tools — that can cut cost on your production boring jobs. You're welcome to put another hole in one of our engineers' heads. Ask them to consider your problem and come up with a cost lowering idea. No obligation, of course.

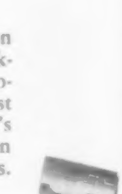
BETTER BORING TOOLS

Madison Cutters in Madison Bars . . . the best in boring tools. Madisons give you superior finishes, in most cases equalled only by grinding. Tolerances to .0003. Two-bladed cutter that expands to make up for wear in regrinding — also quickly changed from one size to another with no disturbance of the set-up. Cutter floats in the bar — no special floating tool holders needed. More holes per cutter before regrinding and more regrinds per cutter (about 10 times as many as similar tools) . . . and many other original Madison features of design.

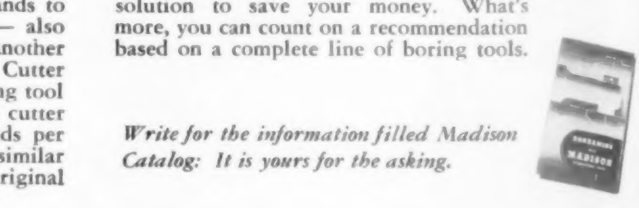
MORE BORING EXPERIENCE

For 35 years Madison has concentrated on solving boring problems. With this background of experience applied to your production job, you can count on the best solution to save your money. What's more, you can count on a recommendation based on a complete line of boring tools.

Write for the information filled Madison Catalog: It is yours for the asking.



SEE MADISON AT BOOTH 513
A.S.T.E. EXPOSITION
PHILADELPHIA APRIL 10-15



MADISON MANUFACTURING CO.
DEPT. TE
MUSKEGON, MICHIGAN

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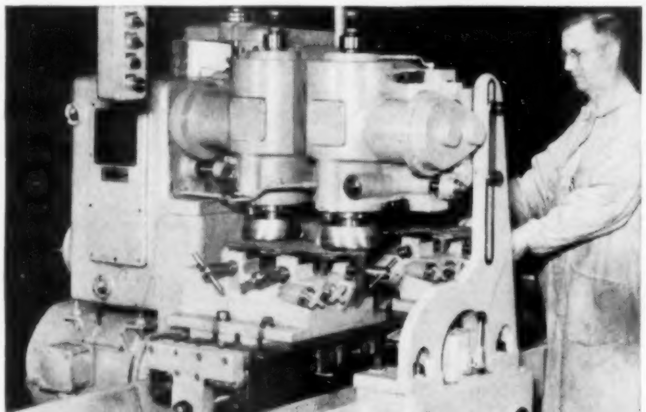
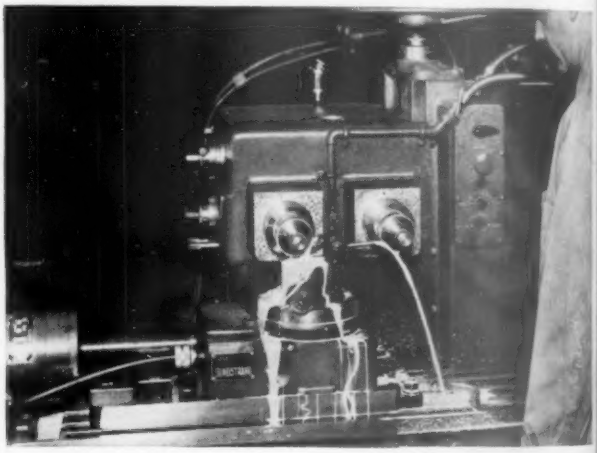
Here's what can be done with Standard Rigidmils . . TO SOLVE SPECIAL MILLING PROBLEMS!

On standard Sundstrand Rigidmils, the head is a self-contained unit which can easily be replaced with a special head. Consequently, when production or work requirements permit machining several surfaces simultaneously, the standard head can be replaced with a special head, and a *special* job done with the lowest possible capital investment. Furthermore, putting into effect product changes (a difficult problem for many production engineers) doesn't worry anybody in plants where Rigidmils are installed. As these machines can be converted so readily to meet product changes, they represent a combination of maximum production with minimum capital investment. Here are six good examples of standard Rigidmils "engineered" to a production job with "only the head as special."



Standard Rigidmil With Two Special Vertical Heads Mounted On Cross Rail Two top pads on thin, cast iron sewing machine bases are milled simultaneously. The table holds two fixtures, one at each end. Operator loads at one end while part is being milled at opposite end. Thus, loading time is free and production increased. Each spindle mills one pad on part, and heads are adjustable on cross rail to facilitate handling a number of different sizes of parts—a good example of special milling production using a standard Rigidmil with only the head being special.

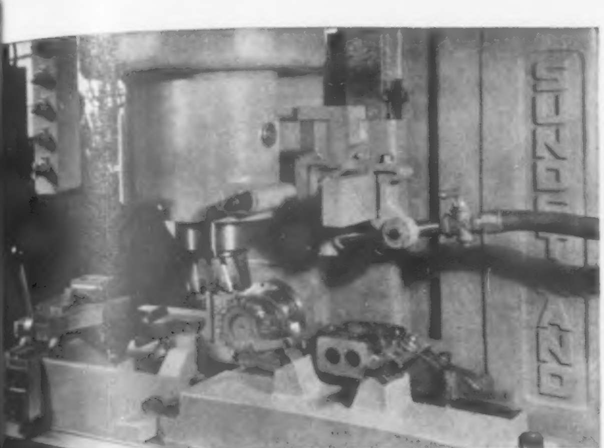


Standard Rigidmil With Special Two-Spindle Horizontal Head

This machine form-mills the teeth in steel clutch drive shafts. Each tooth has a radial undercut on both sides so that the teeth cannot be straddle milled with one cut. For this reason, the standard head was replaced with a special two-spindle head. With an automatic index base centrally located on the table between the spindles, one side of the tooth is formed with the R.H. cutter and the opposite side with the L.H. cutter. After loading the part the operator merely pushes the start button. The machine then automatically forms the teeth by alternate cutting and indexing between the two cutters.

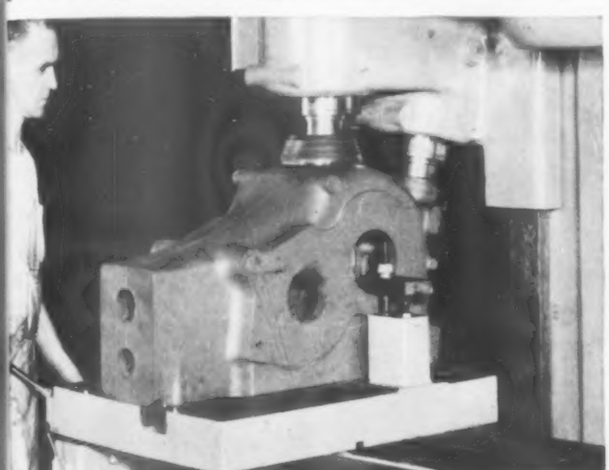
SUNDSTRAND MACHINE TOOL CO. ROCKFORD ILLINOIS U.S.A.

RIGIDMILS • FLUID SCREW RIGIDMILS • AUTOMATIC LATHES • HYDRAULIC EQUIPMENT



Standard Rigidmil With Regular Horizontal Spindle and Special Vertical Spindle

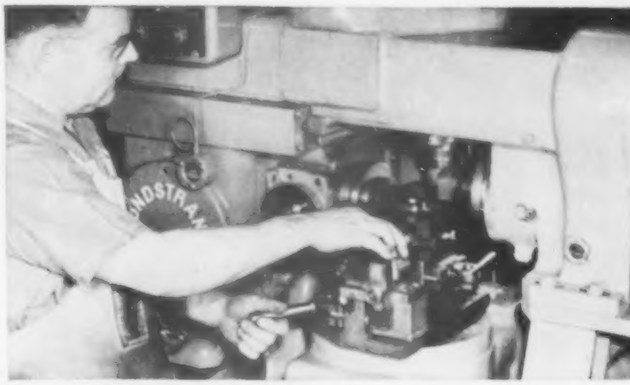
Each spindle carries one carbide tipped cutter. Two fixtures are mounted on the machine table. In L.H. fixture, 2 right angle surfaces of a cast iron manifold are machined, one by horizontal spindle and one by the vertical spindle. Part is then transposed to the R.H. fixture (locating from previously milled surfaces) and a 3rd surafce is machined with the horizontal spindle. Table cycle is automatic so operator can load at one fixture while part is being milled in opposite fixture.



Standard Rigidmil Has Special Head With Vertical and Angular Spindles

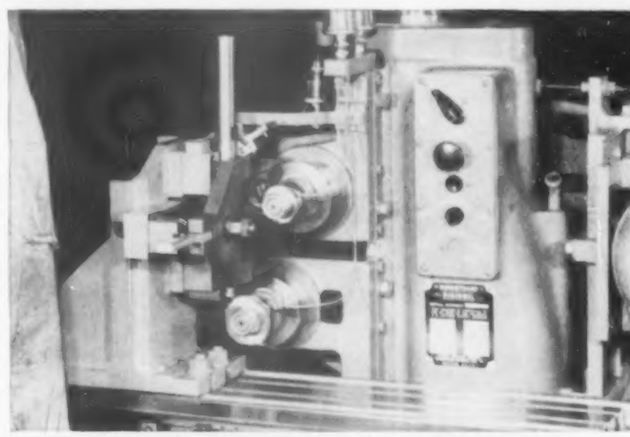
The special angular spindle permits the milling of an angular pad simultaneously with a flat pad on top of tractor frames. These frames, held in a simple, quick-clamping fixture, are milled at the rate of 32 per hour.

Free Data Write for more proof of the successful application of Sundstrand "Engineered" milling production. This new 40 page book contains over 35 actual problem solutions together with interesting tooling diagrams. Write for your copy today. Ask for Bulletin No. 794.



Standard Rigidmil With Special 3 Spindle Head

Three sides of a compressor part are milled on this Rigidmil. Machine also has automatic index fixture so that a part can be loaded in one station while another part is being milled in the 2nd station. Loading time is free and a production of approximately 172 pieces per hour is obtained. Three surfaces are held accurately in relation to each other.



Standard Rigidmil With a Special Two Spindle Horizontal Head

The two horizontal spindles are offset so that while the lower spindle feeds through the diameter of the shaft the upper spindle mills through the O.D. of the shaft, to form the slot in a steel center drive tubing for a washing machine. A simple, manually operated work-holding fixture holds one piece at a time, and an automatic table cycle of rapid approach, feed and rapid return is used to complete 74 pieces per hour.

SUNDSTRAND MACHINE TOOL CO. ROCKFORD ILLINOIS U.S.A.

SUNDSTRAND MACHINE TOOL COMPANY

2540 Eleventh St. • Rockford, Ill., U.S.A.

DRILLING AND CENTERING MACHINES • SPECIAL MILLING AND TURNING MACHINES

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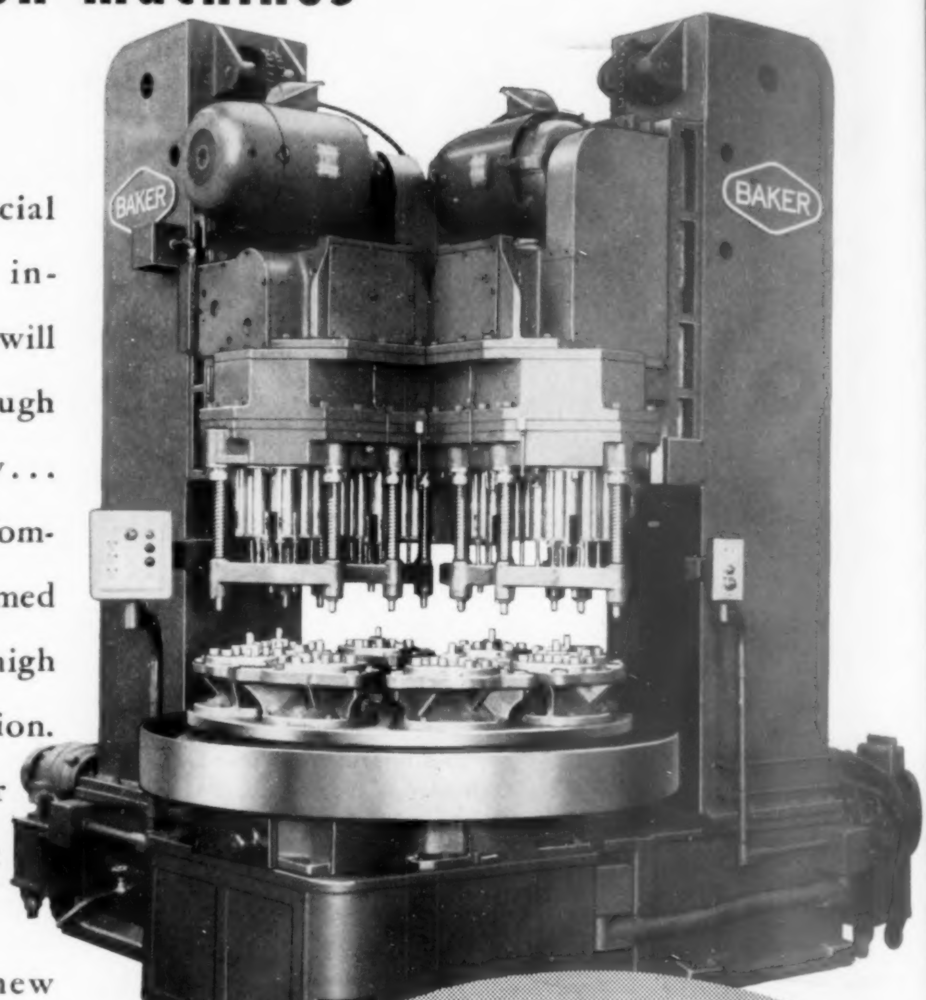
modern milling cutters fo

Indicate A-4-31-

Cut costs...

Replace obsolete equipment with BAKER production machines



A new Baker Special Production Machine installed in your plant will quickly pay for itself through increased productivity... lower cost per part. Combined operations performed simultaneously result in high quality, low cost production. Take inventory in your plant . . . replace that low-production obsolete machine with a new time saving, cost cutting Baker special machine. Consult Baker engineers regarding your specific problems.

New Baker machine drills and reams 9 holes simultaneously on automotive parts at the rate of 480 parts per hour at 100% efficiency. The machine is equipped with a 4 station automatic indexing table and performs operations on two parts at each station.

BAKER BROTHERS, INC., Toledo, Ohio

DRILLING, TAPPING, KEYSEATING and CONTOUR GRINDING MACHINES

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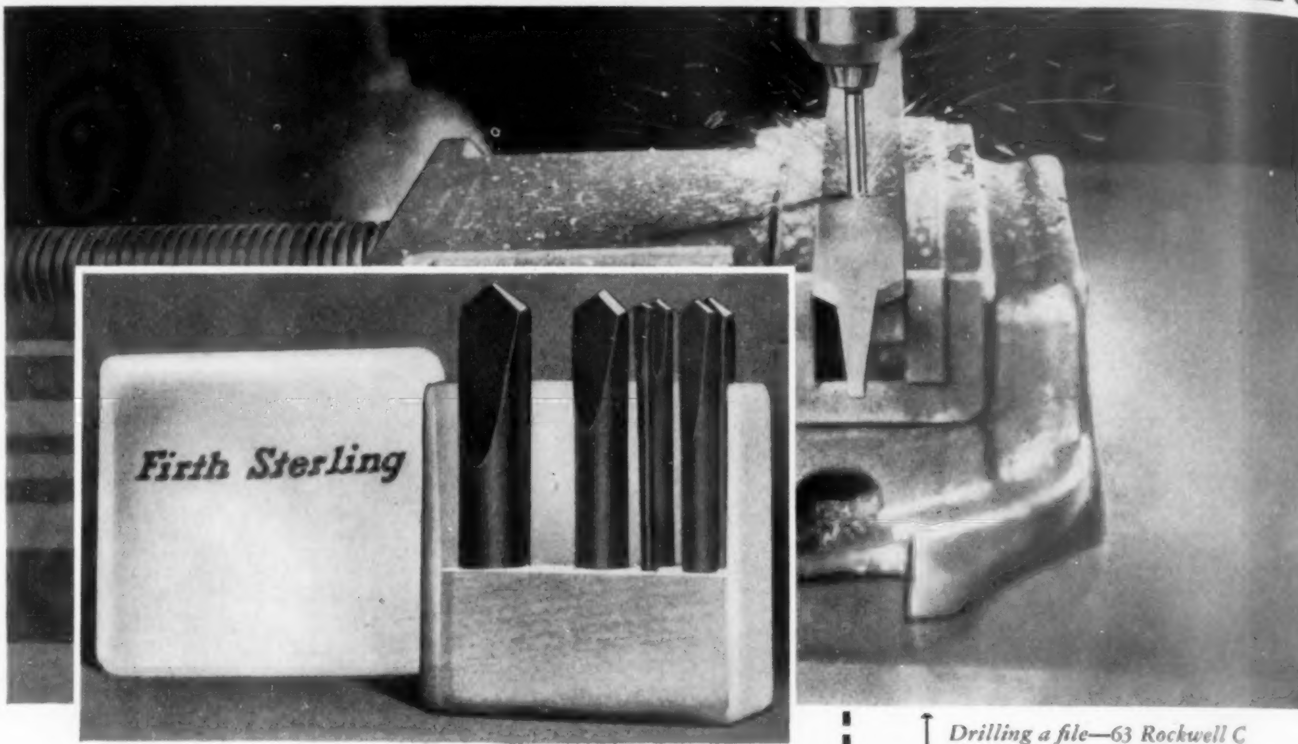
Part One

DRILL HARDEST STEEL!



↑ *Drilling a file—63 Rockwell C Hardness.*

—YOU CAN DO IT

BETTER, FASTER, CHEAPER

WITH SOLID FIRTHITE DRILLS

BETTER Minimize distortion and misalignment of drilled holes by HEAT TREATING FIRST, then drilling the hardened metal with Firthite Drills.

FASTER Drill clean-cut holes without drawing the temper of hardened metal and eliminate "extra" finishing on the surface of the bore.

CHEAPER Low initial cost compared to other types of drills used for similar purpose. Often, drilling a single "forgotten" hole in a hardened die block will pay for the drill many times over!

Assortment of six sizes—1/8", 3/16", 1/4", 5/16", 3/8", 1/2" in Plastic Kit and Index Holder. Individual drill replacements available.

$36
FOR KIT OF SIX DRILLS

THREE WAYS TO BUY FIRTHITE DRILL KITS

1. Buy from your AUTHORIZED FIRTH STERLING DISTRIBUTOR or
2. From your Firth Sterling Sales Representative, or
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Please send___Firthite Drill Kit(s) HMD to:

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OFFICES AND WAREHOUSES in Hartford, Cleveland, Detroit, Chicago, Dayton and Los Angeles
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VISIT FIRTH STERLING BOOTH 1024 AT A.S.T.E. SEE HOW FIRTHITE AND FIRTHALLOY "CUT PRODUCTION COSTS"

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THE COMBINED TECHNICAL experience of 18,000 ASTE members and over 300 exhibitors merges for ASTE's Cost-Cutting Exposition to welcome you with an unparalleled opportunity to return home with the latest information on tool engineering machines and methods.

The American Society of Tool Engineers, in sponsoring this gigantic technical forum of ideas and equipment for American industry, is fulfilling its most important aim—providing tool engineers throughout the United States and Canada with the latest, complete information on tooling and production.

ASTE is a relatively young organization in a relatively old science. Tool engineering through the ages has been a science without a name—a science practiced by exceptional men with a better-than-average working knowledge of available processes and machines, and the ability to use these facilities in the most efficient manner. Many times this also meant considerable improvisation; inventing new tools and new techniques to make something which couldn't be handled by available means.

These men—master mechanics, production supervisors and others—"the only guys in the plant who can make it work or make something else that will", associated on a technical level in 1932 with the organization of ASTE's first chapter.

Industry has fast recognized the importance of organized tool engineering and, as a result, has benefitted tremendously. Tool engineering departments—in some cases newly organized—enabled thousands of manufacturers at the beginning of the war to convert almost overnight to military production. America's tool engineers likewise directed industry's rapid return to peacetime production, in many cases of new products at lower cost.

What does ASTE provide in the way of concrete assistance to tool engineers? Certainly one of the most important aids is participation in national meetings such as the one you are now attending, which offer every year a summary of the best in newly-developed production and tooling techniques. ASTE's chapter meetings are a monthly miniature of its national meetings—presenting technical topics of regional interest each month.

Formal association with one's profession is vital. It is a fundamental way to achieve continued recognition of one's profession, its contributions to science and industry, and its importance. To established engineers it offers the only thorough opportunity to keep abreast of new developments in their profession, as well as the opportunity to develop additional professional contacts. To a younger engineer this association with his profession has a double advantage in furthering his career: his real need for fundamental technical information and his need for industrial contacts.

For the tool engineer's technical library ASTE offers THE TOOL ENGINEER, a monthly chronicle of the best of practical operating data in tool engineering. The Tool Engineers Handbook, a vast repository of tool engineering information, much of it never before published, is another ASTE-sponsored project. ASTE-sponsored standards aid the tool engineer in planning and designing. ASTE's National Standards Committee, in sponsoring technical data sheets, provides the tool engineer with complete design information on hundreds of machine tools, fixtures and accessories, all of which are standardized in format and available as a compact file.

ASTE recognizes the importance of fundamental education in developing new tool engineers for industry, and has taken a lead in assisting educational institutions to devise applicable studies. Its sponsorship of textbooks on tool engineering subjects has been a basic educational aid.

In welcoming you to ASTE's Cost-Cutting Exposition, we know that you will benefit from some of these opportunities; we hope that you will take advantage of all of them.

R. B. Dougl[illegible]
G A Goodwin
H. L. Tigges

WHEN WILLIAM PENN founded the principal city in his Province of Pennsylvania grant, he picked a strategic site midway between the colonies of the north and south. When the American Society of Tool Engineers sought a key spot for the 1950 Tool Engineers' Industrial Cost-Cutting Exposition, they chose the place handiest to the greatest number of America's industrial production men. Like Penn, they decided on Philadelphia. For in the intervening 268 years the Quaker settlement has become the hub of the greatest concentration of population and business in any 100-mile circle in the country. Some 21 million people, 63,000 manufacturing establishments, and 2000 ASTE members are within two hours of the nation's third city.

Nearly 9000 Feet of Counter Displays

But the more than 30,000 visitors expected to line up at the registration desk in Convention Hall for the Exposition and 18th Annual Meeting of the Society, April 10-14, will not be limited to this area. They're coming from all over the United States, from Canada and from overseas to see an 86,000-sq ft showcase of metalworking equipment. It represents, through constant laboratory research and development, the latest efforts of some 325 firms to lower prices and improve quality of consumer goods, and raise the living standards of the world.

You'll have more than 8500 feet of counter frontage to shop—displays of everything from midget mills to what is claimed to be the world's biggest broach. One exhibitor will manufacture aluminum cigarette lighters to demonstrate turret lathe tooling. Another will perform line milling and line grinding with a new machine tool. These recently developed operations are for band machining hard, abrasive, and tough materials.

To stab at random among the hundreds of cost-cutting ideas displayed, there are: jig borers with variable speeds all the way from 90 to 2400 rpm; an automatic machine to drill small holes, consisting primarily of a high speed motor and rotary air compressor on a single armature shaft; a grinder with two wheels, to enable an operator to do rough and finish grinding side by side.

Then there are magnetic perforating dies which can be reset in a fraction of the usual time; an air-operated electrode dresser, said to save time in resistance welding on multiple welding machines; hydraulic fittings that will withstand any amount of vibration without failing; shell type carbide expansion reamers which compensate for tool wear with uniform expansion to 0.0001 in.

Granite inspection tools are machined to 0.00005 in. accuracy; gage blocks are made of materials unaffected by body heat; a feed mechanism brings stamping press production up to as much as 50,000 pieces per hour. A new type of free machining steel having hardenability equivalent of AISI 4150 is being introduced nationally. The petroleum industry is showing advances in machine lubricants, coolants and cutting oils. And one exhibitor has found a way to eliminate drawings by making "white prints" directly from tools and templates.

Show Visitors Invited to Convention Activities

Largest ever sponsored by ASTE, the exposition opens at 9:00 a.m., closes at 5:00 p.m., Monday through Friday. Registration fee is $1 for everyone. As visitors present their invitations, the filled-in registration forms are detached, slipped into badge frames and handed to them as identification to enter the show for the entire five days. Each registrant is welcome to attend technical sessions, plant tours, motion picture shows, the banquet, and other convention events.

An innovation this year is incorporation of the official exposition guide and convention program in this issue of The

America's Home Town Is Machine Tool Capital During

ASTE'S Cost-Cutting

Hundreds of Manufacturers Open Sample Cases at Philadelphia, April 10-14

Tool Engineer. Each visitor receives a copy, along with a sturdy envelope to hold exhibitors' literature.

Aisles are wide to permit group to cluster around demonstrations without clogging traffic. They are plainly and consecutively numbered. Booths are uniformly marked and all on one level. You won't have to climb stairs.

Services Include First-Class Restaurant

Appetizing meals are served in the excellent restaurant in the Convention Hall building, the only such facility in the country equipped with a permanent hotel type kitchen. The food service is managed by a prominent caterer.

Wraps may be left at the checkroom in the passageway between the two main buildings. When you're foot-weary from exhibit touring, relax in the pleasant lounge in the center building; or drop into the theatre off this unit. A five-hour program of industrial films runs each day from 9:30 a.m. to noon and from 1:30 to 4:00 p.m.

If you're looking for a place to sit and chat with a fellow ASTE member, head for the reproduction of the ASTE building facade at the far end of Commercial Museum. This is the Society's headquarters and exhibit of its services and membership benefits. *The Tool Engineer,* "Tool Engineers Handbook" and other ASTE publications are represented in the display.

The Society is also sponsoring an educational exhibit of local tool and die design training, in the center building. The University of Pennsylvania, Drexel Institute of Technology, Villanova College, and Spring Garden Institute are showing how they aid industry with tool engineering courses. As another educational feature, instructors from engineering schools have been invited to escort groups of their students through the exposition.

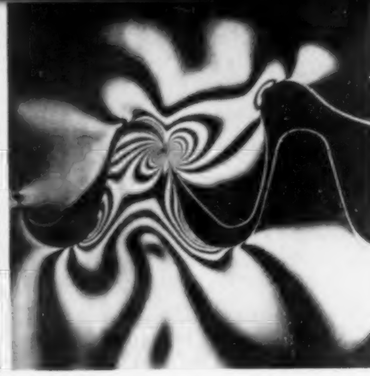
Near the school exhibit the U. S. Department of Commerce offers visitors and exhibitors the facilities of its offices. The Department has data on types of equipment sought by

Although William Penn refused to take off his hat—even to the King—he'd doff his Quaker headgear in salute to the ASTE show, if he could come to life on his City Hall perch.

By Doris B. Pratt

Exposition, Convention

Concurrent Lectures, Plant Tours, Emphasize Engineering Theory, Application



Top, left: A prize-winning photograph by Keith Sisk records an 0.0062-in. drill borihg through an alloy spring and tool steel diesel fuel nozzle, with a machine being demonstrated at the exposition. Right: Franklin Institute made this photoelastic on a rack and pinion to determine stress concentrations in the fillets of the teeth. Lower: PBY 5A seaplanes are overhauled at Philadelphia in the only naval-operated aircraft factory in the U. S.

other countries. Its staff can give foreign buyers information on expediting deliveries abroad. The latest census figures also are on file.

Not-to-be-missed events are the Economic Forum Monday evening at the Academy of Music and the banquet Thursday evening at the Bellevue-Stratford ballroom. The forum participants are tops in economics, business, labor, and the press. What they have to say about the industrial outlook is important to anyone engaged in manufacturing.

While they last, banquet tickets are being sold at the ASTE exhibit, Space 888.

An additional technical session has been announced by the National Program Committee. Albert P. Gagnebin, research metallurgist, International Nickel Co., Inc., New York City, speaks Tuesday afternoon on Machinability and Applications of Ductile Cast Iron. He describes a recently perfected engineering material having small but effective amounts of magnesium-content additive agents. The metal has a controlled conversion of graphite from flake to spheroidal form. Elastically it behaves like cast steel, has high strength and substantial ductility, costs only about 20 cents per pound.

Adapted to Wide Range of Applications

Mr. Gagnebin, co-originator of this new material, presents its machining characteristics, rates of metal removal, tool life, chip form and surface quality. Through low price, steel-like qualities, resistance to thermal shock, growth and oxidation, this type of cast iron is winning varied applications. Suggested uses include crankshafts, pumps, valves, ingot molds, railroad car wheels, engine and furnace parts.

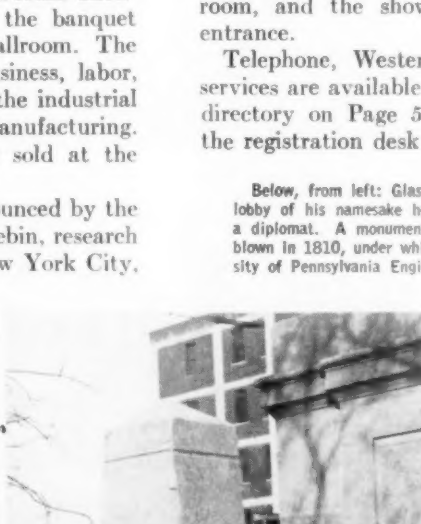
There are elevators to whisk you to the technical session rooms and comfortable upholstered chairs to sit on during the lectures. All the available technical papers are printed in this issue, making it easy for the audience to follow each speaker as he gives his talk. Charts, drawings and photographs illustrating the editorial presentation give the listener a visual grasp of the material discussed. Use the coupon on Page C12 to order transcripts of the discussion periods. Technical sessions are scheduled at 9:00 a.m., 2:00 p.m., and 8:00 p.m.

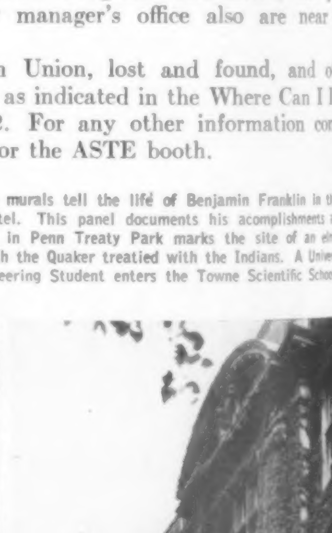
Plant tour buses will leave the main entrance parking lot promptly at 9:00 a.m. and 1:00 p.m. Since some plants can take only a limited number of visitors, you'd better sign up at the registration desk as soon as possible.

The Philadelphia Host Chapter Committee is on duty in the registration area, ready to assist visitors with information about the show, convention, and the city. Women guests may register here for a tour of the Campbell Soup Co. plant at Camden, N. J., Wednesday afternoon. Headquarters of the National Program Committee, the press room, and the show manager's office also are near the entrance.

Telephone, Western Union, lost and found, and other services are available, as indicated in the Where Can I Find directory on Page 52. For any other information consult the registration desk or the ASTE booth.

Below, from left: Glass murals tell the life of Benjamin Franklin in the lobby of his namesake hotel. This panel documents his acomplishments as a diplomat. A monument in Penn Treaty Park marks the site of an elm, blown in 1810, under which the Quaker treatied with the Indians. A University of Pennsylvania Engineering Student enters the Towne Scientific School.





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Banquet


A. R. Diamond*
Asst. Chm., Arrangements


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S. R. Boyer
Emergencies


E. A. Lund*
Signs


W. S. Chalfont
Entertainment


W. J. Griffith
Publicity


H. D. Wood
Motion Pictures

What's going on?

18th Annual Meeting and Exposition

Convention Hall and Commercial Museum
Philadelphia, Pennsylvania

April 10, 11, 12, 13, 14, 1950

Monday, April 10

9:00 A.M.

Registration Opens, Entrance Lobby *

9:30 A.M.

Industrial Films, Theatre off Center Building **

1:00 P.M.

Plant Tours—The Budd Co., Philco Corp., Westinghouse Electric Corp., and Yale & Towne Manufacturing Co.

1:30 P.M.

Industrial Films, Theatre off Center Building

2:00 P.M.

Technical Session, Ballroom, Convention Hall

Developments in Pressworking of Metals, Chairman, Arthur R. Diamond, Mechanical Engineer, Jackson-Walter Co., Philadelphia, Pa.

Forming Sheet Metal by the Marform Process, R. Burt Schulze, General Supervisor of Manufacturing Research, The Glenn L. Martin Co., Baltimore, Md.

Carbide Die Developments, George F. Eglinton, Vice-President, Lincoln Park Industries, Lincoln Park, Mich.

Technical Session, Room 200, Convention Hall

Chairman, Arthur C. Jackson, President, Jackson-Walter Co., Philadelphia, Pa.

Cold Extrusion of Metals, J. Parker Bowden, Engineer, Heintz Mfg. Co., Philadelphia, Pa.

8:00 P.M.

Economic Forum, Philadelphia Academy of Music

Welcome, Robert B. Douglas, ASTE President

Introduction, Paul Wooton, President, Society of Business Magazine Editors

Keynote Address, Walter D. Fuller, President, Curtis Publishing Co., Philadelphia, Pa.

Panel Speakers—Chairman, Dr. Edwin G. Nourse, former chairman, Council of Economic Advisers to the President; Dr. C. Canby Balderston, Dean, Wharton School of Finance and Commerce, University of Pennsylvania; Joseph A. Livingston, Financial Editor, *Philadelphia Bulletin;* and Edward T. Cheyfitz, Secretary, CED Special Policy Committee on Collective Bargaining

Committee of Publishers—Chairman, Joseph S. Hildreth, President, Chilton Co., Philadelphia, Pa.; Robert B. Luchars, President, Industrial Press, New York City; Earl L. Shaner, Chairman of Board, Penton Publishing Co., Cleveland, Ohio

Tuesday, April 11

9:00 A.M.

Technical Session, Room 200, Convention Hall

Chairman, James O. Horne, Sales Manager, James O. Horne & Co., Rochester, N. Y.

Design and Use of Diecasting Dies, Charles M. Franklin, Master Mechanic, Rochester Products Div., General Motors Corp., Rochester, N. Y.

Plant Tours—Baldwin Locomotive Works, Crown Can Co., Link-Belt Co., Radio Corp. of America (Camden), and SKF Industries, Inc.

9:30 A.M.

Industrial Films, Theatre off Center Building

10:00 A.M.

National Education Committee Meeting, Benjamin Franklin Hotel (check bulletin board for room)

1:00 P.M.

Plant Tours—The Budd Co., Philco Corp., Westinghouse Electric Corp., and Yale & Towne Mfg. Co.

1:30 P.M.

Industrial Films, Theatre off Center Building

2:00 P.M.

Technical Session, Room 200, Convention Hall

Chairman, Campbell R. Pittsinger, Production Design Engineer, SKF Industries, Philadelphia, Pa.

Automation of Ground and Turned Production Parts, Nevin L. Bean, Chief Design Engineer, Automatic Transmission Program, Ford Motor Co., Detroit, Mich.

Technical Session, Ballroom, Convention Hall

Chairman, Gardner Young, Tool Supervisor, Westinghouse Electric Corp., Pittsburgh, Pa.

Machinability and Applications of Ductile Cast Iron, Albert P. Gagnebin, Research Metallurgist, The International Nickel Co., Inc., New York City

8:00 P.M.

Technical Session, Ballroom, Benjamin Franklin Hotel

Chairman, Alexander H. d'Arcambal, Vice-President, Pratt & Whitney Div., Niles-Bement-Pond Co., West Hartford, Conn.

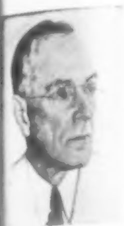
Machinability, Roy T. Hurley, President, Curtiss-Wright Corp., Wood-Ridge, N. J.

Technical Session, Rose Room, Bellevue-Stratford Hotel

Trends in Drilling, Chairman, Harmon S. Hunt, Plant Superintendent, Sipp-Eastwood Corp., Paterson, N. J.

Application of Drill Units to Standard and Special Machinery, Eugene Numrich, Application Engineer, Avey Drilling Machine Co., Cincinnati, Ohio

Micro-Drilling, John A. Cupler II, General Manager, National Jet Co., Cumberland, Md.


W. D. Fuller


C. C. Balderston


E. G. Nourse


J. A. Livingston


E. T. Cheyfitz


Paul Wooton

Wednesday, April 12

9:00 A.M.

Technical Session, Room 200, Convention Hall
Chairman, David J. Heckinger, Vice-President, Tools, Inc., Ardmore, Pa.

Industrial Applications of Metamics, W. O. Sweeny, Jr., Assistant Sales Manager, Haynes-Stellite Div., Union Carbide & Carbon Co., Kokomo, Ind.

Plant Tours—Baldwin Locomotive Works, Crown Can Co., Link-Belt Co., Radio Corp. of America (Camden), and SKF Industries, Inc.

9:30 A.M.

Industrial Films, Theatre off Center Building

10:00 A.M.

Board of Directors Meeting, Ballroom, Benjamin Franklin Hotel

House of Delegates Caucus, Betsy Ross Room, Benjamin Franklin Hotel

1:00 P.M.

Plant Tours—The Budd Co., Philco Corp., Westinghouse Electric Corp., and Yale & Towne Mfg. Co.

1:30 P.M.

Industrial Films, Theatre off Center Building

2:00 P.M.

Technical Session, Room 200, Convention Hall
Chairman, Gerald A. Rogers, Sales Engineer, Rudel Machinery Co., Ltd., Montreal, Que.

Cold Roll Forming of Metals, Elmer J. Vanderploeg, Assistant Chief Engineer, The Yoder Co., Cleveland, Ohio.

Technical Session, Ballroom, Convention Hall

Automation, Chairman, John C. Whitesell, Superintendent of Plant Engineering, The Budd Co., Philadelphia, Pa.

Automation in Forging and Heat Treating, Thomas E. Darnton, Supervisor of Standards, and Willard L. Mautz, Supervisor of Production Engineering, Oldsmobile Forge Plant, General Motors Corp., Lansing, Mich.

Automation in the Press Room, Herman F. Zorn, President, V & O Press Co., Hudson, N. Y.

8:00 P.M.

Technical Session, Ballroom, Benjamin Franklin Hotel
Chairman, James R. Weaver, Vice-President, Baldwin Locomotive Works, Philadelphia, Pa.

Tooling Up For Modern Truck Engine Production, Joseph Olender, Mechanical Engineer, International Harvester Co., Indianapolis, Ind.

Technical Session, Rose Room, Bellevue-Stratford Hotel
Chairman, Charles F. Stephenson, Chief Process Engineer, York Corp., York, Pa.

Use of Element Time Data for Effective Tool Design, Norris M. Perris and H. K. Keever, Partners, Stevenson, Jordan & Harrison, Inc., New York City

Thursday, April 13

9:00 A.M.

Technical Session, Ballroom, Convention Hall

Hard Surfacing of Production Tools and Gages, Chairman, Erik A. Lund, Chief Tool Engineer, Link-Belt Co., Philadelphia, Pa.

Nitriding of High Speed Steel Tools and Gages, J. G. Morrison, Chief Metallurgist, Landis Machine Co., Waynesboro, Pa.

Hard Chrome Plating, Brayton A. Taylor, Vice-President, Chrome Electro-Forming Co., Detroit, Mich.

Plant Tours—Baldwin Locomotive Works, Crown Can Co., Link-Belt Co., Radio Corp. of America (Camden), and SKF Industries, Inc.

9:30 A.M.

Industrial Films, Theatre off Center Building

10:00 A.M.

House of Delegates Meeting, Ballroom, Benjamin Franklin Hotel

1:00 P.M.

Plant Tours—The Budd Co., Philco Corp., Westinghouse Electric Corp., and Yale & Towne Mfg. Co.

1:30 P.M.

Industrial Films, Theatre off Center Building

2:00 P.M.

Technical Session, Ballroom, Convention Hall
Chairman, Peter A. Patterson, Past Chairman, Philadelphia ASTE Chapter

Broaching Applications for Cost Reduction, Oliver W. Bonnafe, Chief Research Engineer, The Lapointe Machine Tool Co., Hudson, Mass.

Technical Session, Room 200, Convention Hall
Chairman, Frank J. DeFrates, Superintendent, Kruse & Slattery, Camden, N. J.

Automation in Hopper Feeds for Assemblies, Charles E. Kraus, President, Kraus Design, Inc., Rochester, N. Y.

7:00 P.M.

Banquet and Annual Membership Meeting, Ballroom, Bellevue-Stratford Hotel

Annual Report to Membership
Address
Installation of National Officers
Presentations
Entertainment

* Exhibits open from 9:00 A.M. to 5:00 P.M., daily.
** Complete film showing daily from 9:30 A.M.-12:00 Noon and from 1:30-4:00 P.M..
Check bulletin boards in lobby, for changes in schedule.

and Friday, April 14

9:00 A.M.

Technical Session, Ballroom, Convention Hall
Chairman, Dwight H. Renfrew, General Superintendent, Link-Belt Co., Philadelphia, Pa.

Design Economics, John VanHammersveld, Supervisor, Design Cost Control Group, The Glenn L. Martin Co., Baltimore, Md.

Plant Tours—Baldwin Locomotive Works, Crown Can Co., Link-Belt Co., Radio Corp. of America (Camden), and SKF Industries, Inc.

9:30 A.M.
1:30 P.M.

Industrial Films, Theatre off Center Building

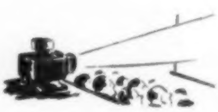
2:00 P.M.

Technical Session, Ballroom, Convention Hall
Chairman, Edmund Hollingsworth, President, Tools, Inc., Ardmore, Pa.

Investment Casting, Thomas F. Frangos, Sales Engineer, Haynes-Stellite Div., Union Carbide & Carbon Corp., Kokomo, Ind.

Technical Session, Room 200, Convention Hall
Chairman, Emil Kitzman, Sales Engineer, W. E. Shipley Machinery Co., Philadelphia, Pa.

Effect of Latest American Standards on Lathe Spindle Deflections, Dr. Max Kronenberg, Consulting Engineer, Cincinnati, Ohio



Movies you'll like

Big Boy—Production of largest broach ever made

* * *

An American Miracle—Job Setup and Operation

* * *

Grinding and Use of Basic Lathe Tool Cutter Bits

* * *

This Is Resistance Welding

* * *

Die Casting

* * *

The Human Bridge—Automotive Production

Pay Loads Pay Off—Materials Handling

* * *

Multipress and How You Can Use It

* * *

Physics of Metal Cutting

* * *

The Easier Way—Job Planning and Control

* * *

Tools and Rules for Precision Measuring

* * *

Generation of Metallic Bearing Surfaces

See bulletin boards for daily time schedule

G. F. Eglinton

C. M. Franklin

J. G. Morrison

Joseph Olender

N. L. Bean

W. O. Sweeney, Jr.

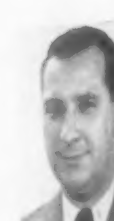
Eugene Numrich

W. L. Mautz

R. B. Schulze

T. E. Darnton

J. P. Bowden



T. F. Frangos

Accustomed as they are . . .

Convention speakers are experts on their subjects, but did you know that . . .

DR. MAX KRONENBERG has served as a machine tool and metal cutting expert before the Supreme Court of Germany and Federal Courts in the U. S. During World War II he was a consultant to the Secretary of War in Washington, to improve and increase war production. Author of a book on metal cutting investigations in the U.S. and abroad, he is a member of Sigma Xi, a society for the promotion of scientific research . . . **Eugene Numrich,** a University of Cincinnati man, placed vocational education in prominent plants while assistant coordinator of this activity for the Southwest district of Ohio . . . **N. M. Perris** has taught factory management at the University of Pennsylvania, was an Army Prove Officer in World War I.

H. K. Keever is a member of Tau Beta Pi engineering fraternity, once directed the engineering and manufacturing of automatic can-making machines . . . A former professional wind-tunnel model builder, **John Van Hammersveld** has lectured on design cost control at the Glenn L. Martin Engineering Training School, is the author of "Designing with Dollars" and other trade paper articles . . . **Roy T. Hurley** has served in two world wars. In the first conflict he was inspector of airplanes and airplane engines in the Army Air Force. As Deputy to the Chief of Ordnance in World War II, he set up industry integrating committees.

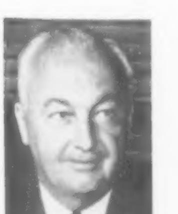
John A. Cupler II, a native of Detroit, was graduated from Potomac State College; holds patents on inventions relating to micro-drilling and the manufacture of synthetic filament spinnerets . . . **T. F. Frangos** earned his master's in mechanical engineering at Purdue University, has done research for the chemical and dye industries; was an Army Signal Corps captain from 1942-46 . . . **E. J. Vanderploeg** climbed the hard way to assistant chief engineer of his company, augmenting his technical high school education with evening courses. He has spent 25 years designing and supervising the engineering of cold rolled forming machines.

N. L. Bean is a Registered Professional Engineer in Michigan, belongs to the Automobile Old Timers, is active in JIC standardization and chairmans the Sub-Group on Castings for the SAE drafting room manual now in preparation . . . **C. M. Franklin** grew up with the automotive industry, beginning as an assembler with the old Remy Electric Co. at Anderson, Ind.

J. P. Bowden holds B.S. and M.E. degrees from Towne Scientific Institute and the University of Pennsylvania, is an R.P.E. in that state . . . **G. F. Eglinton** had his toolmaking apprenticeship with the Anderson Electric Car Co. interrupted by the first world war, continued his education at Midwest technical institutions during 12 years as an itinerant toolmaker . . . Starting in 1942 as metallurgical consultant on hard facing, welding rods and special tools, **W. O. Sweeny, Jr.** in two years became Chief of the Wrought Steel Section of the Metallurgical Branch of the War Production Board at Washington.

Besides manufacturing machines, giving technical talks and writing trade paper articles, **H. F. Zorn** is vice-president of the Hudson River Trust Co., Hudson, N. Y. As president of the Columbia Memorial Hospital, he chairmans a building committee in charge of a $2 million addition to the institution . . . A University of Michigan alumnus, **C. E. Kraus** has been an instructor in the metal processing department of his alma mater. He gave up an industrial research post to make automatic parts handling equipment and assembly machines . . . For outstanding achievement during the late war, **O. W. Bonnafe** carried off the Certificate of Merit of the National Metal Trades Association, is a member of the committee for removing metal on aircraft gas turbines, working out of Wright-Patterson Field, Dayton, Ohio.

R. B. Schulze had a book, "Aluminum and Magnesium Design and Fabrication," published last year, studied mechanical engineering at Carnegie Tech and aeronautical engineering at Curtiss-Wright Technical School . . . **T. E. Darnton** has been with General Motors ever since he came out of Michigan State College with his B. S. in 1938 . . . **W. L. Mautz,** an Ohio State M.E., had six years in the field as sales engineer before joining Oldsmobile in 1942 . . . **J. G. Morrison** has written numerous papers and articles in connection with high speed steel . . . **Joseph Olender,** who has the responsibilities of a master mechanic, has contributed 24 years' experience to the program he is describing . . . While grinding efficiency engineer at the Maxwell Chalmers Corp., predecessor to Chrysler, **B. A. Taylor** installed the first grinding wheel salvage department in any Midwest automotive plant.



R. T. Hurley

H. K. Keever

John VanHammersveld

J. A. Cupler II

Max Kronenberg

E. J. Vanderploeg

N. M. Perris

C. E. Kraus

B. A. Taylor

H. F. Zorn

O. W. Bonnafe

Busman's Holiday

Visiting tool engineers tour local plants to see how other fellow does it

AFTER THE COLONIES had told off the British, Philadelphia hustled around and set up ordnance plants to help clinch the argument. Today it is an important center of and purveyor to military installations. And largely through the increased tempo of each successive wartime operation, metals and metal products have passed all its other industries in dollar value.

When things quieted down after the War of 1812, a Philadelphia journeyman jeweler seeking a more practical business teamed up with a machinist and wood engraver. They began making book publishers' tools and binding machinery, competing with the import market. Then they formed copper cylinders for printing calico. Unable to find a steam engine to power the expanding industry, the former jeweler designed and constructed one himself. Before long the manufacture of such engines became their principal business.

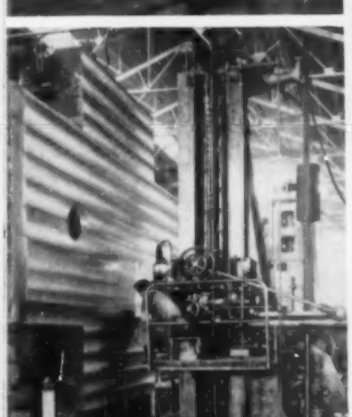
Now when you visit the Baldwin Locomotive Works you'll find that Matthias Baldwin's successors are still broadening their range of products. They turned out part of the hydraulic equipment that raises and lowers the stage at Radio City Music Hall, propellers that drive the *SS America*, auxiliary diesel engines for the tanker *MS Dynafuel*. They've just completed a 664,000-lb press to produce rubber conveyor belting in large sections. Their locomotives join remote parts of foreign countries. Baldwin engineers will show you how they process such diverse equipment.

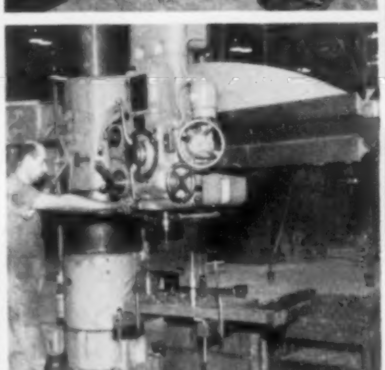
A relative newcomer in an historic location is the Steam Division of Westinghouse Electric Corp. It sprawls over 475 acres of Tinicum Island, a delta sloughed off by the mucky Schuylkill River ages ago. Some 40 years before Penn arrived, a company of Swedes settled here, built a fort, chapel and governor's mansion less than half a mile from the present plant entrance.

As ASTE parties go through this entrance, company guides will escort them to manufacturing departments working on steam turbines, reduction gears, steam condensers, pumps and air ejectors. If your feet hold out you can go on and see feedwater heaters, cooling units, ventilating blowers, compressors and perhaps a land gas turbine. Of especial interest is the procedure for cutting teeth in large reduction gears. Hobbing, done in an air-conditioned room, continues day and night for three weeks. Since the cutting tool generates, all subsequent teeth will be slightly out of position if work is stopped, then resumed after the metal cools.

Behind the clear pictures that flicker over your television set is rigid quality control. At the RCA plant in Camden you'll see more than 1000 parts, assembled with rivets, screws and some 500 crimping and soldering operations, going into every set. Materials are carefully examined. Assembly line inspectors check each part, circuit and component. A test pattern is inspected for faults, its characteristics correlated with the receiver. Next the IF and RF circuits are aligned, checked for wave shape response and sensitivity. All variable controls are adjusted. In the deflection test

Upper left: Fumes escape up an exhaust as a worker welds a transmitter frame in the RCA engineering products department. The largest spherical roller bearing ever built in the U. S. is assembled at SKF Industries. Each of the 52 rollers weighs 35 pounds. Lower, left: A Baldwin Locomotive worker faces the steel base casting for a vertical 5,000,000-lb. capacity universal testing machine. Right: Five pieces are clamped in place to be drilled in one operation at Yale & Towne Mfg. Co.





characteristics must meet exacting standards.

Yale & Towne planned their recently opened plant Philadelphia, they laid out the machinery and equipment ry to make hoists, scales and industrial trucks, then d them with walls and a roof. The result is a remark- dy in materials handling and production efficiency. pots to linger over on this trip are the machine shop hoist assembly lines, the overhead conveyor for dry- ll painted parts, the truck-circuit for handling prod- d chain making machinery. Paint is being piped h the plant like water to serve the finishing depart-

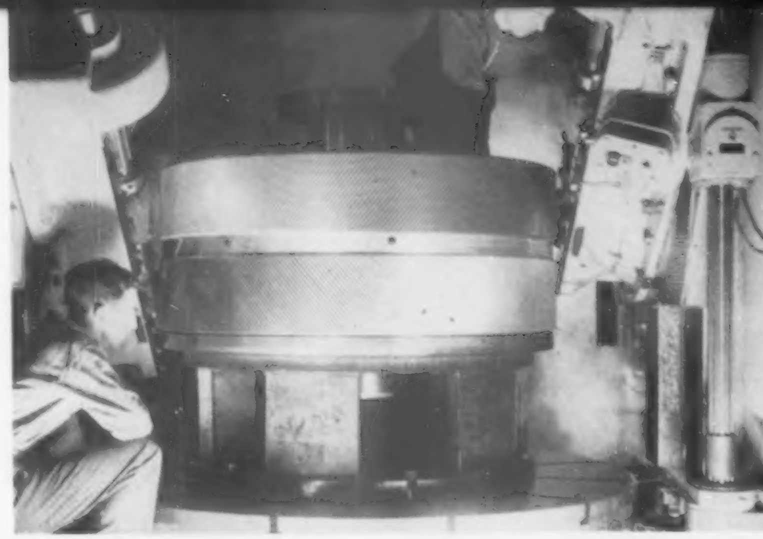
-Belt Co. concentrates on the conveyor phase of ls handling. Here you'll see foundry, forging and operations on speed reducers, worm and herringbone gear motors, variable speed drives, chains and chain ts. From processing of components the trip continues h the fabrication of elevator, belt, apron, slat and other of conveyors.

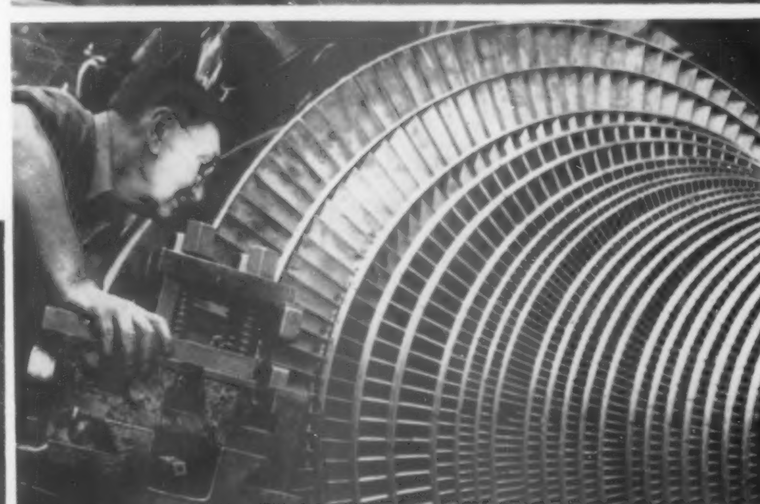
'll find conveyors put to good use at Crown Can Co. of tinplate are fed into litho presses, decorated, then ed to baking ovens. Emerging the sheets are re- d, carried to slitter departments and cut into body d pieces. An operator feeds body parts into an auto- high-speed machine which produces a soldered cylinder. uently, other machines flange both ends of the body r, double seam one end, and air test the can.

ng the depression '30's The Budd Co. tackled the tion of stainless steel, came up with its Shotweld for welding the light but rugged material, along with ques and tools for forming it. Their research led to odern light-weight railway cars bringing thousands of tioners to Philadelphia. Budd representatives will ex- how ribbons of steel are run through heavy rollers to corrugations, then welded together into roof sections. welding tool has its own electronic timer which also a graphic record of each weld on a paper tape.

SKF Industries men and machines are busy transform- ls of wire into tiny steel balls half the size of a pin- These blanks for tipping ball-point pens are formed rate of 21,000 per hour. Each day thousands of bear- rts in thousands of sizes are constantly checked during on grinding.

from top: Twin hobbers cut teeth in large gears being manufactured at ouse Electric Works. A 42-foot vertical boring mill, one of the largest in d, machines a Baldwin hydraulic turbine ring. Sheets of tinplate feed into press at Crown Can Co. to be decorated before baking and fabricating into s. A Westinghouse employee seals the shroud of a moderate sized steam Welders join this side frame, one of several sub-assemblies for stainless steel cars built at The Budd Co. Below: Ribbons of stainless steel are corrugated ng them through heavy rollers, later welded together to form railroad car ions.





Above: The elevation on which the Philadelphia Museum of Art stands was a suggested site for William Penn's mansion. Aquarium buildings are in the foreground. Left, from top: From his post in front of Independence Hall Commodore John Barry shows how he commanded the master of the British tender Edward to surrender in 1776, as the first commissioned officer of the U.S. Navy to capture a foreign ship. Left center: In this house at 530 N. 7th Street, Edgar Allan Poe labored over some of his melancholy tales. Right: One of the richest homes of the colonies, Mt. Pleasant was Benedict Arnold's gift to his bride. Visitors to Fairmount Park admire its Chippendale furnishings. Although 88 miles from the Atlantic, the Port of Philadelphia is the nation's second busiest.

"LET EVERY HOUSE be placed . . . in the middle of its Plot . . . so that there may be Ground on each side for Gardens . . . that it may be a greene countrie Towne which will . . . always be Wholesome."

William Penn's instructions in 1681 to his commissioners are as apt today as then. But, immersed in becoming a manufacturing metropolis, Philadelphia gradually lost the founder's vision. It became inured to its crowded, sooty factory town, went along its ultra-conservative way, reluctant to be disturbed by change. Now it is up and doing, tearing down wornout housing, putting up new, charting super expressways, cleaning out rivers, improving community services. A pleasant "wholesomeness" begins to shine through the housecleaning.

Shooting off diagonally from City Hall, the tree-aisled Benjamin Franklin Parkway points like a green arrow to the

Below, from left: Old houses on Camac Street between Spruce and Pine are characteristic of early Philadelphia. The clock and bell in the Germantown Town Hall formerly told the hours from Independence Hall. Gloria Dei or Old Swede's Church, standing since 1700, is the oldest house of worship in Philadelphia.

Photos courtesy Philadelphia Convention and Visitors Bureau

'greene countrie Towne'

greater verdure of Fairmount Park. This in turn spreads to the Wissahickon extension to form a 3000-acre playground. No major city encloses such a spacious, natural breathing spot. Other retreats scattered over the urban area follow meandering streams, surround quiet lakes, reservoirs and lagoons.

As you stroll along the magnificent Parkway boulevard, you pass impressive public buildings. Beneath a rooftop reading room and gardened terrace, the Free Library covers a former potter's field. Opposite, Franklin Institute demonstrates applied science, does research for industry; Fels Planetarium dramatizes the travels of the celestial bodies. From a bluff overlooking the Schuylkill River, the Museum of Art commands a panorama of the skyline. Behind the museum the Aquarium dangles its feet in the river. Farther on is the cabin occupied by General Grant at City Point, Va., and the zoo. Looking much as it did when Benedict Arnold gave it to his bride is Mt. Pleasant, a colonial mansion built when the mid-city park was on the outskirts of town.

* * *

For a flashback to Philadelphia's history making days, you'll seek out such downtown landmarks as the Independence Square buildings, the Betsy Ross house and Carpenters' Hall. But you may not recognize the Tom Thumb Sandwich Shop at 7th and Market as the spot where Jefferson drafted the Declaration of Independence. Better known is the location of his office as the first Secretary of State, now marked with a marble memorial at the entrance of the Strawbridge & Clothier department store.

Through the iron fence around the Old Christ Church Burial Ground on Arch Street you can read the epitaphs on the tombstones of Benjamin Franklin and his wife Deborah.

The spot where Thomas Jefferson had his office as the first Secretary of State is enshrined in this marble memorial at the entrance of the Strawbridge & Clothier department store.

Some of the town's first settlers rest in the graveyard of the Old Swede's Church, built in 1700. Established five years earlier, Christ Church has occupied its present Georgian edifice since the middle 1700's. A simple stone shaft in Penn Treaty Park reminds passersby that it was here that the Quaker made his unsworn pact with the Indians.

* * *

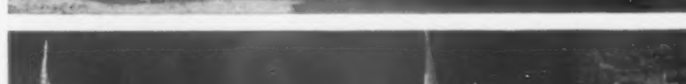
Ageless in classic beauty the granite and marble home of the first and largest U.S. Mint rolls, cuts, stamps and mills metals to keep this and other nations in pocket money. Be sure to study its walls and ceilings. They depict the development of the arts and crafts in irreplaceable gold mosaic faced with Tiffany glass.

Philadelphia also has the oldest Navy Yard in the country, its only naval operated aircraft factory. The Quartermaster Depot which outfitted the Lewis and Clark expedition now makes army uniforms, flags and other equipment. Most ancient Federal installation is the Schuylkill Arsenal, and the active Frankford Arsenal has more than a century of munition and arms production behind it.

The third nationality group to settle in Philadelphia retains its identity in the Old Germantown quarter. Two-century-old inns, mansions and cottages give it a nostalgic charm. Listen to the bell in the Town Hall as it calls out the hours. A thousand Spanish dollars are said to have been melted to achive its remarkable tone.

Even if the exposition and convention keep you too busy for sightseeing, you can take in the University of Pennsylvania Museum. It's just a block across the campus from Convention Hall.

Upper: This cabin in Fairmount Park once sheltered General Grant at City Point, Va., during the siege of Richmond. Below: Benjamin Franklin and his wife sleep beneath slabs in Christ Church Burial Ground.



Where's a good place to . . .

Eat

Arthur's Steak House—216 Chancellor

Louis G. Bauerle, Inc.—14 S. 15th. Specialties Snapper Soup and Cheese Cake

Convention Hall Restaurant

Homestead—1913 Walnut. Colonial type of service

Old Original Bookbinder's—121-7 Walnut. Seafood house

Russian Inn—1233 Locust

Shoyers—412 Arch

2601 Parkway Dining Room—26th and the Parkway

Dine and dance

Barclay Hotel—18th and Rittenhouse Sq.

Empire Room—Ritz-Carlton Hotel, Broad and Walnut

Stratford Garden—Bellevue-Stratford Hotel—Broad and Walnut

Warwick Room—17th and Locust

See Spring Flowers

Horticultural Hall—Fairmount Pk., 9-5 daily. Free. Display of Easter lilies

Longwood Gardens—Kennett Sq., Pa. 11-5 daily. Free. Sun., 60c. Easter flowers, orchids

Shop

The Blum Store—1300 Chestnut

Bonwit Teller—Chestnut at 17th

Gimbels—9th and Market

Lousols—Chestnut St. at Juniper

Oppenheim Collins—1126 Chestnut

Russeks 5th Ave.—1210 Chestnut

Snellenburgs—Market and 11th

Strawbridge & Clothier—8th and Market

John Wanamakers—13th and Chestnut Sts. Open 10 to 5:30 daily. Fashion Show, April 11

Department and center city stores open Wed. until 9 p.m.

Admire Fine Art

Art Alliance—251 S. 18th St. Free

Penna. Academy of Fine Arts—Broad and Cherry. Closed Mon. Weekdays, 10 to 5, Sun., 1-5

Phila. Museum of Art—25th and Parkwy. 9:30 to 5 daily and Sun.

Free Library—19th and Parkwy. Weekdays, 9 a.m.-10 p.m. Sun., 2-10 p.m. National Snapshot Awards

Be entertained

The Click—Market at 16th

Garden Terrace—Benjamin Franklin Hotel, 9th and Chestnut

Legitimate Theatres—Forest, 114 Walnut; Locust St., 1411 Locust; Shubert, 250 S. Broad; Walnut St., 9th and Walnut

Little Rathskellers—Broad and Spruce

Palumbo's—824 Catharine

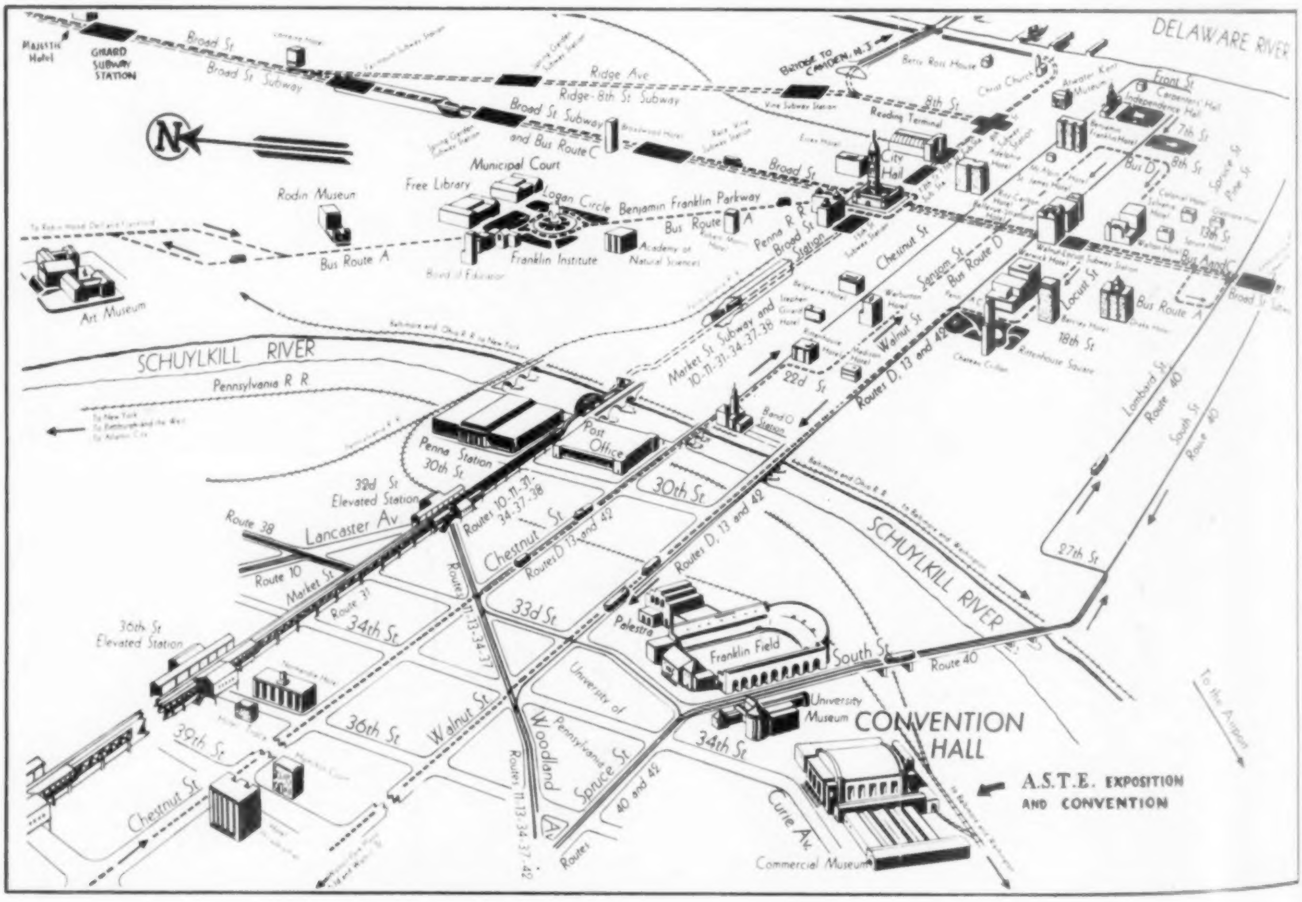
Take off from this world

Fels Planetarium—Benjamin Franklin Parkway at 20th St. Rocket to Mars (Imaginary), leaving 3:00 p.m. daily and Sun. Additional trips: Sat. 11 a.m. and 2 p.m.; Sun. 2 p.m.; Wed., Fri., Sat., 8:30 p.m. No trips Mon.

Hear good music

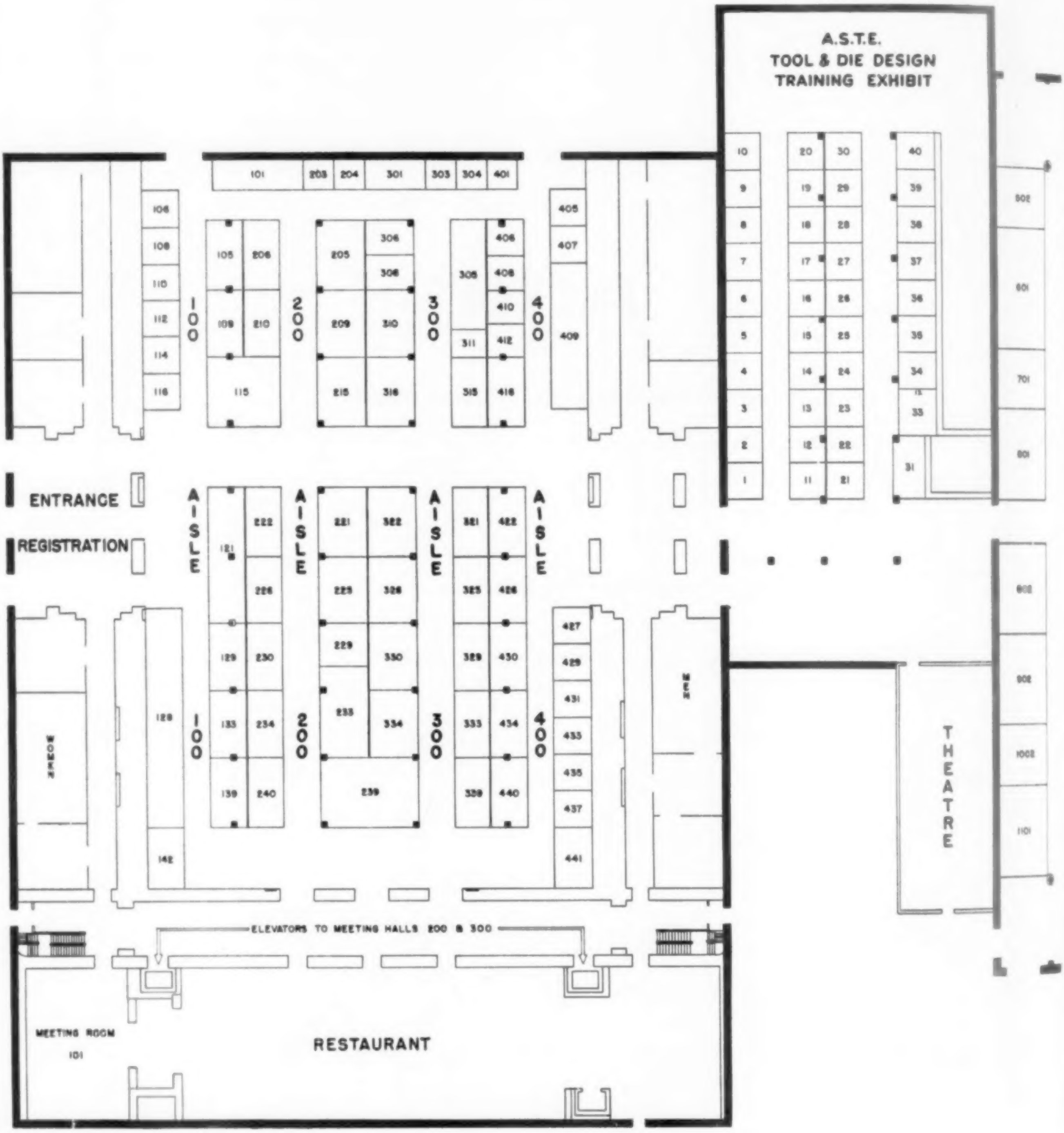
Academy of Music—Broad at Locust. Philadelphia Orchestra, Wagner program. April 10, 14,—2:30 p.m.; April 15, 8:30 p.m.

John Wanamakers—13th at Chestnut. Program in Grand Court 12 noon and 5:15 weekdays, except Wed. noon. April 12 Concert by Germantown Youth Orchestra

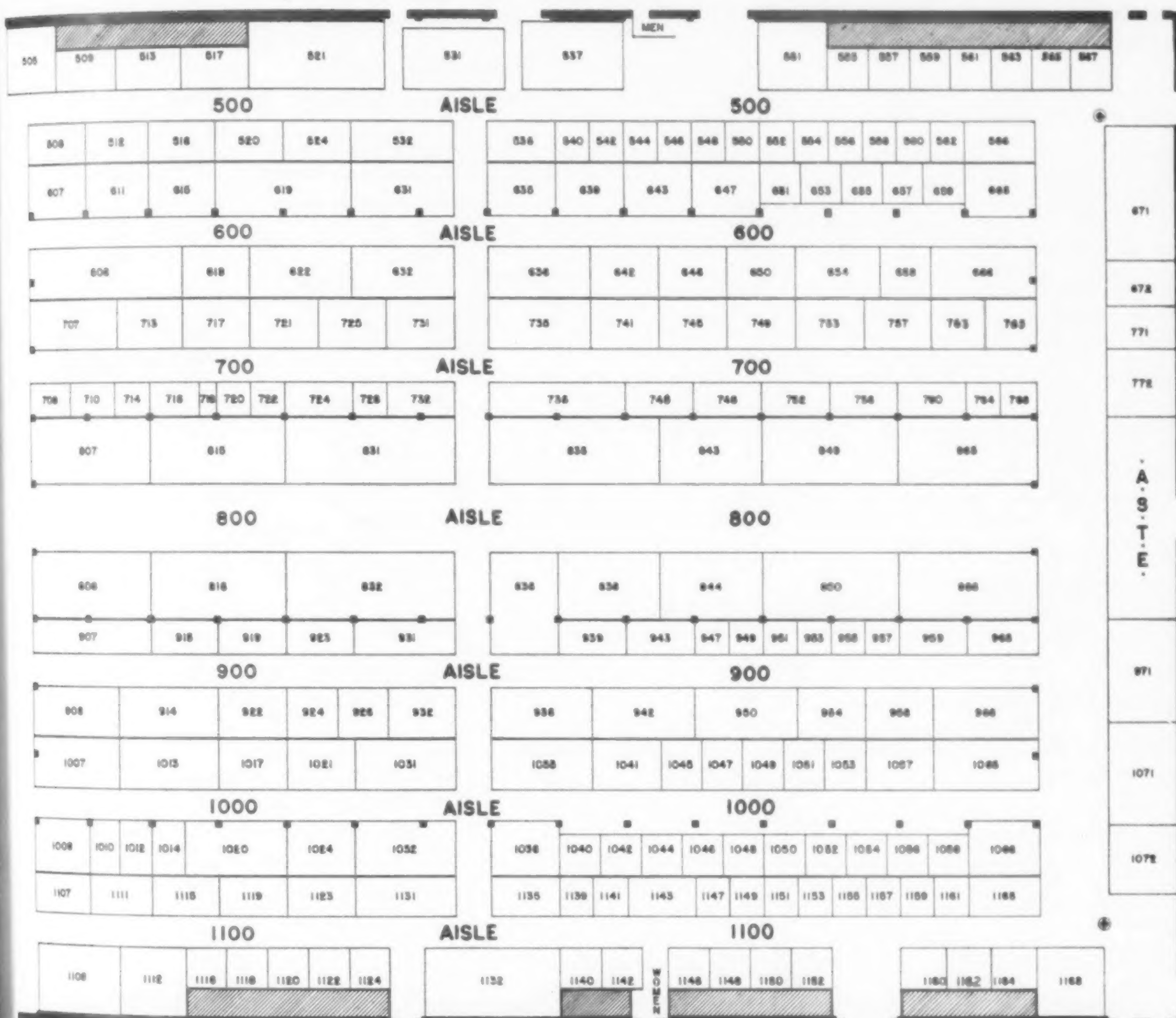


Part Two

Floor Plan of Philadelphia's



Convention Hall and Museum



Where can I find . . . ?

ASTE HEADQUARTERS
Space No. 888, at the far end of Commercial Museum.

BANQUET TICKETS
May be purchased at ASTE Headquarters, Space 888.

CHECKROOM
In passageway between Convention Hall and Commercial Museum.

EXHIBITORS' SERVICE OFFICE
Located in the Center Building.

EXPOSITION MANAGER'S OFFICE
Room 103, near main entrance.

EXHIBITS

Space Numbers	Aisles	Located in
1- 40		Center Building
101- 441	100- 400	Convention Hall
502-1168	500-1100	Commercial Museum

LOST AND FOUND
Finder please return lost article to Registration Desk. Please report losses promptly.

LOUNGE
For your leisure a lounge is provided in the Center Building.

MOVIE THEATRE
Off Center Building; open from 9:30 A.M. - 12 Noon and from 1:30 - 4:00 P.M. Entrance through Commercial Museum.

OFFICIAL PHOTOGRAPHER
Arrange for exhibit pictures with the photographer in Exhibitors' Service Office, Center Building.

PARKING
Parking areas are adjacent to Convention Hall.

PHILADELPHIA HOST CHAPTER HEADQUARTERS
Registration area.

PLANT TOURS
Sign up at the Registration Desk. Buses leave from main entrance parking lot.

PRESS ROOM
Headquarters for newspaper and trade paper representatives are in Room No. 105, near main entrance.

PUBLIC REST ROOMS
Conveniently located throughout the buildings.

PUBLIC TRANSPORTATION
One block north at Spruce and 34th Streets.

REGISTRATION DESK
Entrance lobby of Convention Hall.

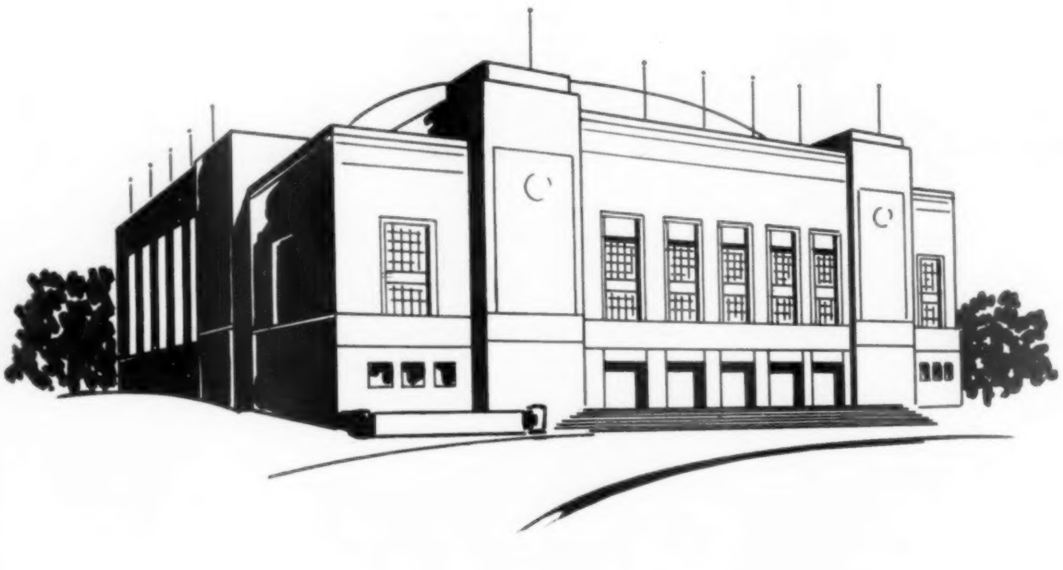
RESTAURANT
For a light snack or a full course meal you'll like the restaurant in the west corridor of Convention Hall.

TECHNICAL SESSIONS
Take elevators next to the restaurant, to Room 200 and Ballroom.

TELEPHONES
Conveniently located throughout the buildings.

TO LOCATE A FRIEND
Inquire at the information desk in the ASTE booth. If he has registered at the Exposition, his hotel or private residence address and phone is on file.

WESTERN UNION
Exhibitors' Service Office, Center Building.



Exhibitors, Products, Personnel...

142 **ACCURATE BUSHING COMPANY**
443 North Ave.
Garwood, N. J.

In attendance—C. S. Einsiedler, J. Wm. Ekegren, Jr., Carlton Eberhard, Joseph T. Hanlon, Albert R. Dorn.

Drill jig bushings, standard and special

1148 **ACE ABRASIVE LABORATORIES, INC.**
250 West 57th St.
New York 19, N. Y.

In attendance—Benjamine Greenfield, Fergus Magee, Charles Trabulus, Theodore Spector, Herbert B. Collins, Jr., Milton J. Huill, John J. Kelly.

Pure diamond powders and lapping compound

234 **ACME STEEL COMPANY**
2840 Archer Ave.
Chicago 8, Ill.

In attendance—J. H. Prout, C. J. Bruneel, V. J. Fiore, N. J. Lynch, E. P. Crim, C. F. Coleman, M. G. McGuinn, V. F. Murphy.

Metal stitcher

766 **ACME TOOL COMPANY**
71 West Broadway
New York 7, N. Y.

In attendance—M. Ehrenhaus, Frank A. Corrao, J. P. Scipione.

Tool holders, surface plates, angle plates, parallels, straight edges, master angle plates, precision grinding vise, sine plate, angle parallels, compound blocks

406 **ADAMAS CARBIDE CORPORATION**
1000 S. 4th St.
Harrison, N. J.

In attendance—Edward L. Dreyer, W. H. Jones, W. Pflug, A. J. Fischer, Tungsten carbide tool tips, dies, and wear parts.

1040 **ADEL PRECISION PRODUCTS CORPORATION**
10777 Van Owen St.
Burbank, Calif.

In attendance—Fred T. Miller, Tom Fitzgibbon, Ted Affleck, J. Boyd Coates, I. Casper.

Simulated milling machine operated by industrial hydraulic units comprising pump, rotary pilot, relief, flow control, free-flow restricted and pilot-operated 4-way valves

1122 **AIRBORNE ACCESSORIES CORPORATION**
Tool Division
25 Montgomery St.
Hillside 5, N. J.

In attendance—W. Cortlyn Rhodes, J. F. Mohan, Leon A. Marantz, Sam Fiedel, Cliff Thompson, Bill Hopkins, Harry Jakobsen, T. P. Orchard, Charles Kamuda, Louis Ross.

728 **AIR SPEED TOOL COMPANY**
1500 West Slauson Ave.
Los Angeles 47, Calif.

In attendance—H. J. Thiessen, W. J. Thiessen, Roy Von Seggern, Walter J. Braun, Robert G. Zimmerman, Mrs. H. J. Thiessen, Mrs. Roy Von Seggern.

Portable pneumatic saw and file

434 AJAX ELECTRIC COMPANY, INC.
Delaware and Frankford Aves.
Philadelphia 23, Pa.

In attendance—G. H. Clamer, William Adam, Jr., John E. Haig, L. B. Rosseau, H. W. Kerst, A. R. Yerkes, Q. D. Mehrkam, John P. Clark, Miss Ann E. Hamilton.

Electric salt bath furnace installations, batch and mechanized units; demonstration

618 ALLEGHENY LUDLUM STEEL CORPORATION
Pittsburgh, Pa.

In attendance—W. H. Wills, L. V. Klaybor, R. S. Ahlbrandt, Clark W. Green, Paul Rehner, Barney Miller, P. E. Floyd, R. T. Eakin, W. H. Bleecker, F. Price Norris, Jr., Coolidge Sherman.

Steel—before machining—tips, carbide replacement

524 ALLEN MANUFACTURING COMPANY
133 Sheldon St.
Hartford 5, Conn.

In attendance—W. D. Horner, Ellsworth Brash, Ivan Smith, Kirk Hobart.

Hex socket set and shoulder screws, socket and flat head cap and square head set screws, socket pipe plugs, dowel pins, hex keys and allenuts

665 ALLIED PRODUCTS CORPORATION
12677 Burt Rd.
Detroit 23, Mich.

In attendance—W. S. Smith, L. Coulter, R. Wild, J. T. Moriarty, F. Bishop, L. E. O'Dell, W. L. Mills, L. Richards, A. J. Fleming, P. J. Fleming.

Interchangeable punches and dies, cold forged parts, high carbon cap screws, hardened and precision ground parts

206 ALLISON COMPANY
257 Island Brook Ave.
Bridgeport 8, Conn.

In attendance—C. D. Cummings, H. R. Powell, G. J. Casserly, E. C. Scanlon, R. F. Robbins, R. J. Bowllan.

Rubber and resinoid bonded abrasive cut-off wheels, soft rubber polishing wheels

718 ALPHA CORPORATION
3 Seneca Place
Greenwich, Conn.

In attendance—A. Sonntag, C. E. Sonntag, S. R. Hazelett.

Molykote—bearing pressure lubricant

226 AMERICAN CHAIN & CABLE COMPANY, INC.
(see Campbell Machine Div.)
also
(see Wilson Mechanical Instrument Co., Inc.)

659 AMERICAN MACHINE & FOUNDRY COMPANY
5502 Second Ave.
Brooklyn 20, N. Y.

In attendance—Charles Wiedmann, Charles Thiel, W. Ross Stevens, H. H. Smith, E. T. Parke, T. G. Dalrymple.

Fully automatic chucks and tapping attachments, woodworking machine, radial arm saw

416 AMERICAN MACHINIST
McGraw-Hill Book Company, publishers
McGraw-Hill Bldg.
New York 18, N. Y.

In attendance—Albert Hauptli, Jr., W. E. Kennedy, Adkins Lowell, Burnham Finney, E. J. Tangerman, J. H. Koch, D. G. Jones, R. Deen, J. P. Tiebout, R. H. Anderson, A. F. Tischer, P. G. Weatherby, J. A. McGraw, G. Reppert, H. Britton.

American Machinist, information pertinent to interest of tool engineers

958 AMERICAN PULLMAX COMPANY, INC.
2627 North Western Ave.
Chicago 47, Ill.

In attendance—E. G. Kihlstrom, L. W. Behrendt, Wm. Grasmick, David Arvidsson.

Sheet steel and plate cutting machines, various sizes and capacities

1131 AMPCO METAL, INC.
1745 South 38th St.
Milwaukee 15, Wis.

In attendance—S. C. Lawson, J. P. Henry, O. B. Frohman, E. E. Whitson, J. E. Cook, J. W. Nebel, C. S. Goodwin

Forming dies and punches, guide post bushing for die stamping die sets; boring bar wear strips, plus examples of production

888 AMERICAN SOCIETY OF TOOL ENGINEERS
10700 Puritan Ave.
Detroit 21, Mich.

In Attendance—H. E. Conrad, Maxine Bobbish, Frank W. Wilson, J. S. Eacock, Edythe Reichart, Frances E. Watson, Stanley F. Girard, Jeanne Barman, Kenneth Carroll, Margaret Mason, Allen Ray Putnam, Gilbert P. Muir, A. E. Rylander, Doris B. Pratt, Dorothy Taylor, Austin Cragg, C. T. Etter, J. E. Hartnett.

Complete information on ASTE activities, chapters and service to members and industry, THE TOOL ENGINEER magazine, Tool Engineers Handbook, ASTE standards and data sheets, other publications sponsored by the Society

710 **B. C. AMES COMPANY**
12 Ames St.
Waltham 54, Mass.

In attendance—Warren Ames, H. B. Kruse, B. C. Ames, E. W. Goodwin.

Micrometer dial indicators and micrometer dial gages

1107 **AMPLEX MANUFACTURING COMPANY**
Subsidiary of Chrysler Corporation
6510 Harper
Detroit 31, Mich.

In attendance—A. J. Langhammer, A. H. Merschel, D. B. Martin, R. E. Briston, K. Kuhlen, L. Printz, H. Speck, Frank Beemer, A. J. Diesinger, Jr., H. G. Silcox III, J. B. Waterhouse, J. E. Blizzard, M. H. Beemer, S. M. Krauser, A. H. Schwarz, J. C. Barba, J. M. Brower, A. H. Couture.

Bronze, iron, stainless steel, Oilite, oil-cushioned, heavy-duty bearings, cored and solid bars, machine parts, friction units

329 **ANDERSON & SONS INC.**
NORTH ELM ST.
WESTFIELD, MASS.

In attendance—Roland E. Anderson, A. M. Anderson, W. H. Smith, D. M. Anderson.

Nameplates, dials, panels, gages, scales, rules, camera plates

422 **F. E. ANDERSON OIL COMPANY**
Brownstone Ave.
Portland, Conn.

In attendance—F. E. Anderson, T. C. Bradford, J. S. Martin, C. A. Sluhan, J. Howard Kennedy, A. W. Ackerman.

Cost cutting fluid, machine cleaner, water conditioner, rust preventives

1056 **R. B. ANNIS COMPANY**
1101 N. Delaware St.
Indianapolis 2, Ind.

In attendance—R. B. Annis, M. F. Annis, H. A. Franz.

Dynamic balancing machine, electric etcher, demagnetizers

17 **ANTON MACHINE WORKS**
1226 Flushing Ave.
Brooklyn 6, N. Y.

In Attendance—J. Anton, Loretta Anton, H. Grabiner.

Magnetic and non-magnetic parallels, transmitting tube parts

5 **APEX TOOL & CUTTER COMPANY, INC.**
237 Canal St.
Shelton, Conn.

In attendance—F. J. Wilson, Sr., H. M. Sheridan, F. J. Wilson, Jr., F. D. Glover.

Metal cutting tools, inserted tooth milling cutters, tools and holders, 2-way holders

521 **ARMSTRONG-BLUM MANUFACTURING COMPANY**
5700-5800 Bloomingdale Ave.
Chicago 39, Ill.

In attendance—Harry J. Blum, Gus M. Hess, Van Austin, Karl Arenz, Ted A. Slezak, Walter G. Stockdale, Martin Stanlionis.

Various hack saw machines, universal metal band sawing machine, high-speed-edge hack saw blades and hole saws

1047 **ARMSTRONG BROS. TOOL COMPANY**
5273 W. Armstrong
Chicago 30, Ill.

In attendance—Horace Armstrong, H. B. Austin, R. B. Ansell, T. P. Sawyer, C. E. Chase, T. F. Lynch, K. E. McGroder.

Portable power pipe threader, tool holder system, hand tools, machine tools and accessories

741 **ARO EQUIPMENT CORPORATION**
Bryan, Ohio

In attendance—R. W. Morrison, L. L. Hawk, E. L. Jackson, G. K. Scholte, O. D. Hitt, C. A. Konstance, T. F. O'Malley, A. B. Schuhl, G. S. King, W. N. Parke, C. P. Enston, C. N. Douglass, M. J. Anderson, H. D. Hamilton.

Air tools, airline lubricators, balancers, quick hose couplers, electrode dressers

654 **E. C. ATKINS AND COMPANY**
402 So. Illinois St.
Indianapolis 9, Ind.

In attendance—R. W. Nightingale, L. C. Garvin, R. V. Merrell, E. S. Norvell, R. Schmitt, Frank T. Wruk, Frank Duwell.

Saws—metal, wood, plastic, saw tools, machine knives

1008 **ATLAS PRESS COMPANY**
2012 N. Pitcher
Kalamazoo, Mich.

In attendance—G. C. Nancarrow, H. D. Herder, H. B. Hazerodt, J. C. Pittfield, Martin Miller, James Gottesman, C. E. Blanchard, E. H. Marsland.

Bench and floor type ball bearing drill presses, bench type milling machines, metalworking shapers, back-geared screw cutting lathes

520 **AUSTENAL LABORATORIES, INC.**

(see Microcast Div.)

408 **AUTOMOTIVE INDUSTRIES**

(see Chilton Co.)

339 **W. O. BARNES COMPANY, INC.**

1297 Terminal

Detroit 14, Mich.

In attendance—J. W. Bennett, R. E. Bournonville, O. G. Roberts, F. M. Shaw, D. P. Shellabarger, V. H. Olson.

Metal cutting hack and band saws and saw blades, Red Rocket power blade

407 **BAUSCH & LOMB OPTICAL COMPANY**

635 St. Paul St.

Rochester 2, N. Y.

In attendance—M. H. Stevens, J. I. Wexlin, G. C. Crebbin, P. Gentsch, R. Tackaberry, O. Boughton, E. G. Koch.

Toolmakers, shop and Brinell microscopes, Widefield tubes and binocular microscopes, contour and measuring projectors, para-plane gages and 3 in. thickness measure

966 **BAY STATE ABRASIVE PRODUCTS COMPANY**

Union Street

Westboro, Mass.

In attendance—E. H. Brister, E. W. Farmer, R. A. Green, F. A. Hughes, E. J. Geib, E. B. Jones, W. E. Moody.

Abrasive specialties, Bayflex, DuraCut and Saf-T-Cut products, grinding wheels and honing stones

35 **BAY STATE TOOL & MACHINE COMPANY**

412 Albany St.

Springfield 4, Mass.

In Attendance—Alfred E. Gaudreau, Norman W. Gaudreau, Alfred N. Gaudreau.

Toolroom equipment, hand tapping machines with drilling attachments

433 **BEAVER TOOL & ENGINEERING CORPORATION**

2850 Rochester Rd.

Royal Oak, Mich.

In attendance—A. E. Streadwick, J. R. Miller, R. L. Blanchard, William Johnson, C. L. Lindegren, Jr., Ed. Hollingsworth, Richard Melnick, Herb Taylor, T. J. Fraser, Wm. Scheer, Eugene Roth, Robert Bayles, Chester S. Fischer, H. D. Geisler.

Quick change tool holders for milling and boring machines, standard milling machine arbors, adaptors and reducing sleeves, solid carbide inserted blade milling cutters

802 **THE BELLOWS COMPANY**

222 W. Market St.

Akron 4, Ohio

In attendance—F. R. Bellows, H. B. Link, W. C. Richards, Jr., J. M. McComb, W. C. Butcher, James J. Mudd, Harold Granger, C. E. Blixt, W. G. Buckley, W. L. Buell, C. E. Chute, C. S. Draper, J. H. Frye, J. R. Gordon, G. A. Gray, D. B. Guy, B. O. Hultgren, W. R. Jessup, B. B. Larson, F. J. Moses, F. F. Newell, S. H. Nimmo, K. W. O'Neil, A. E. Scott, Jr., A. K. Scriven, F. V. Stauffer, R. B. Watkins, R. C. Gross.

Air motors, feeds, cylinders, vises and valves; air-powered rotary feed tables and impact presses

1054 **BEMIS & CALL COMPANY**

125 Main St.

Springfield 2, Mass.

In attendance—H. A. Lincoln, S. A. Lincoln, F. G. Kelley, R. W. Kelley, A. A. Metcalf.

Milling attachment for vertical and horizontal milling machines

1150 **BENCHMASTER MANUFACTURING COMPANY**

2950 W. Pico Blvd.

Los Angeles 6, Calif.

In Attendance—Gerald Florence, M. K. Grey, J. Spievak.

Standard and deep-throat presses, horizontal milling machine, rotary table, lathe attachment swivel vise and similar parts for punch presses

333 **BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY**

901 Cleveland St.

Elyria, Ohio

In attendance—F. L. Wheaton, E. B. Rhodes, H. C. Bothe, Jr., H. J. Begin, C. J. Lindegren, Jr., C. J. Lindegren, Sr., F. T. Donnelly, P. Boyle.

Air cylinders, valves, controls, air operated jigs and fixtures

658 **BENZON MACHINE COMPANY**

7th and Washington Ave.

Lansdale, Pa.

In attendance—George H. Benzon, Jr., William F. R. Benzon, Robert W. Moyer.

Coordinators, recorders and spacing attachments

724 BLACK DRILL COMPANY
1400 E. 222nd St.
Cleveland 17, Ohio

In Attendance—J. A. Remeke, F. G. Gepfert, C. P. Morgan, R. Henning, R. B. Hogue, O. A. Muenz, William E. Raney, W. J. Whatley, H. M. Wiltshire.

Drills for dry and wet drilling, automatic drilling units for drilling in all types material

919 EDWARD BLAKE COMPANY
437 Cherry St.
West Newton 65, Mass.

In attendance—Edward Blake, Lewis Wright, Clifford H. Keller, William G. Shaw, David M. Warren, A. M. Schmidt, A. J. Ulichny, Howard M. Keller, Charles H. Reeder.

Flute grinder, tap chamfer grinders, black diamond precision drill grinders, cutter sharpener, surface finish standards, tool holders

401 HENRY P. BOGGIS & COMPANY
706 E. 163rd St.
Cleveland 10, Ohio

In Attendance—Henry P. Boggis, Carl F. Schleicher.

Tap grinder and general purpose abrasive cut-off machine

1139 BOICE-CRANE COMPANY
930 W. Central Ave.
Toledo 6, Ohio

In Attendance—M. H. Buehrer, Stuart Tate, Richard Noyes, Russell Wells, Frank Tenure, Frank M. Lee.

Combination contour saw-band filer, drilling and tapping machines

1049 BOKUM TOOL COMPANY
14775 Wildemere Ave.
Detroit 21, Mich.

In Attendance—F. Heuser, Wm. Scheer, L. Slager, Geo. Laughter, Harry Jenkins, O. Mueller, K. J. Papke, Art Blessington, A. Soulen, B. Gray, M. J. Lloyd, Walter Rankin, Jos. Dalgliesh, John Williams, Jr., A. L. Hacker, M. A. Siebert, A. Gorsky.

High speed steel and carbide tipped boring, bottoming and internal threading tools; solid carbide precision boring tools; jig boring sets, fixed and adjustable tool holders; resharpening fixtures, turning and external threading tools

133 BOYER-SCHULTZ CORPORATION
2110 Walnut St.
Chicago 12, Ill.

In attendance—Walter H. Brooke, Wm. Bunnell, Chas. A. Dussmann, Edw. Baumruck, Walter Obstefelder, W. O. Kellogg, Jay O. Achenbach, R. C. Gray.

Surface and profile grinders; screw machine tools; copper head laps; special machine bolts

657 BRAMSON PUBLISHING COMPANY
(see Production Engineering & Management)

431 BREHM DIE DIVISION
(see the Steel Products Engineering Co.)

1031 BRIDGEPORT MACHINES, INC.
643 North Ave.
Bridgeport 6, Conn.

In attendance—Rudolph F. Bannow, Magnus Wahlstrom, Edward T. Kiernan, P. A. Rebok, E. H. Noren, Jr.

Turret milling machines and attachments and accessories

567 BRINNELL COMPANY
Hartford Ave.
Granby, Conn.

In Attendance—J. G. Schnell, E. C. Brill, W. H. Robertson, T. S. Mederos, Jr., C. F. Gordon, E. L. Mahl, R. C. Wilson, E. A. LaPointe, V. Hendricks.

Protectron, protective electronic control device

849 BROWN & SHARPE MANUFACTURING COMPANY
235 Promenade St.
Providence 1, R. I.

In Attendance—Paul R. Hatch, Wallace E. Anderson, Harold B. Schott, John H. Biggs, William T. Nystrom, James J. McAleese, James F. Tingley, Harry C. Watt, John F. Hines, Herbert Richardson.

Machine tool attachments and accessories, inspection equipment, pumps, chucks, collets, spur gear testing fixture, punches

801 CHARLES BRUNING COMPANY, INC.
100 Reade St.
New York 13, N. Y.

In Attendance—R. B. Graves, T. J. Gilmour, A. Halstead, R. B. Webb, J. M. Gilmour, F. E. MacVaugh, H. C. Havekost, W. Cavanaugh, W. W. Hersperger, C. Renninger, Dewitt C. Smith, J. Fineran, J. Riff, R. Hodges, J. P. Arndt, F. DiCanio, E. G. Davison.

33 **THE BRUSH DEVELOPMENT COMPANY**

3405 Perkins Ave.

Cleveland 14, Ohio

In Attendance—A. J. W. Novak, H. Harsant, F. C. Gilmour, John Burnett.

Dual channel and universal amplifier, D-C amplifier, surface and strain analyzer, single and double channel oscellograph

3 **BRYANT CHUCKING GRINDER COMPANY**

257 Clinton St.

Springfield, Vt.

In attendance—R. P. Scholl, H. H. Gates, A. E. Stubbs.

Thread gages of all types

924 **CADILLAC GAGE COMPANY**

20316 Hoover Rd.

Detroit 5, Mich.

In Attendance—C. A. Pennell, Tom Thompson, Harold Burkart, C. H. Bauer.

Measuring instruments, thread, cylindrical and special built-up gages

753 **CADILLAC STAMP COMPANY**

2136 Riopelle Ave.

Detroit 7, Mich.

In attendance—E. H. Novak, C. Nelsen, A. Mullen, F. Cooper, D. Cooper, A. GeWertz.

Marking and branding machines

226 **CAMPBELL MACHINE DIVISION**

American Chain & Cable Company, Inc.

Bridgeport, Conn.

In Attendance—V. E. Lysaght, W. Leopold, M. Vogel, O. H. Shettler, R. B. Coleman, C. H. Thompson, J. L. Kavalaris, P. A. Kenyon, Paul Fee.

Cut-off and rotary cutting machines, nibblers

736 **CARBOLOY COMPANY, INC.**

11177 E. Eight Mile Rd.

Detroit, 32, Mich.

In Attendance—W. G. Robbins, K. R. Beardslee, J. E. Gillespie, E. C. Howell, J. W. Mason, G. M. Chandler, J. M. Bertotti, P. Holton, G. Burr, T. E. Hayes, R. Hudaverdi, J. W. Middeker, C. P. Quick, F. H. Schonberger, A. M. Thomson, J. L. Whitmore, E. Rauss, P. Schick.

Standard single point and insert tools, standard and special blanks, masonry drills, diamond wheel dressers and grinding cones, screw machine applications, wear resistant applications, coal mining and woodworking tools

1101 **THE CARBORUNDUM COMPANY**

Niagara Falls, N. Y.

In attendance—F. J. Tone, Jr., F. W. Bonacker, J. G. Fritzinger, F. W. Scott, Jr., B. H. Work, W. T. McCargo, F. A. Upper, W. K. Van Ormer, David Currie, David Houtz, John W. Ripple, K. M. Williams, W. G. Lautz, W. A. Corse, Stuart Wolf, R. D. Rutt, F. T. Keeler, M. S. Ireys, P. J. Speyser, Jos. E. Rice, K. S. Duffes, James Edminson, J. A. Decker, R. H Huntington, L. Kiriloff, J. M. Piper, H. L. Henszey, R. S. Lafferty, A. H. Straub, E. W. Adams, J. F. Hill, R. F. MacGonigal, W. Telfer

Grinding wheels; cloth and paper abrasives

1123 **CHICAGO RIVET & MACHINE COMPANY**

96 W. Jackson Blvd.

Bellwood, Ill.

(Br. factory, Tyrone, Pa.)

In Attendance—Wm. O. Shineflug, John Kanet, R. T. Brosius, Wm. Fahey, Jos A. Rehm, R. S. Christie, A. L. Calhoun, C. Reineck, D. Reineck, Vincent Scully, Jr.

Tubular, split and bifurcated rivets in steel, brass, iron, copper, aluminum, monel; automatic rivet setters

408 **CHILTON COMPANY**

(Automotive Industries)

Chestnut & 56th Sts.

Philadelphia 39, Pa.

In Attendance—Joseph S. Hildreth, G. C. Buzby, J. R. Custer, H. H. Roberts, R. P. Homer, C. B. Rawson, Frank Tighe, N. W. Sieber, J. F. Pfeffer, C. W. Hevner, E. H. Miller.

Automotive Industries, industrial automotive news; *Commercial Car Journal*, maintenance and operation of truck and bus fleets; *Motor Age*, automotive service and repair

955 **CHROME ELECTRO-FORMING COMPANY**

7515 Lyndon Ave.

Detroit 21, Mich.

In Attendance—James J. Morey, Brayton A. Taylor, J. F. Mulvoy.

Hard chrome plating of gages, broaches, gears, automotive and aircraft parts

636 **CITIES SERVICE OIL COMPANY**

ARKANSAS FUEL OIL COMPANY

60 Wall Tower

New York 5, N. Y.

In attendance—Joseph Reynolds, I. M. Niedling, D. Gallaher, W. Schenck, M. Keyes, Merle Smith, F. L. McGiffin, F. Mutz, J. McCabe, Fred Blatz, George Staples, W. J. Varetoni, B. B. Mears, J. J. Dorr, Jack Tracey.

All types of industrial oils; motor oils, greases; neutral and bright stocks; solvents, and combustion analyzers

225 CIRCULAR TOOL COMPANY, INC.

765 Allens Ave.

Providence 5, R. I.

In Attendance—G. H. Nye, R. F. Anderson, M. D. Pilon, G. Ryone, A. Jeffs, J. Clements, Fred McMillen, Fred Kern, Wayne Cather, Donald Robertson, Andrew Spruce, Robert Kuntz, James O. Horne, R. E. Nelson, A. J. Ulichny, O. S. Mitler, Ben Mitler, Robert Henning, J. W. Kelly, Walter Greene, Robert Clark, George Tutrow, Herbert Morrison, William Ensley, Ted Parmelee, Louis Wasmund, Oliver D. Scott, Edward Voss, C. W. Draeger, E. J. Schnieder, W. C. Towne.

Solid carbide and carbide tipped circular metal cutting saws; combined drills and countersinks, and center reamers

1159 CLEVELAND INDUSTRIAL TOOL CORPORATION

1080 East 222nd St.

Cleveland 17, Ohio

In Attendance—Joe Loecy, Jr., Hunter N. Williams, Lee Loecy.

Hydraulic automatic diamond turner, solid copper diamond tools

1057 CLINTON MACHINE COMPANY

Franklin & Division Streets

Clinton, Mich.

In Attendance—Frank E. Bugher, Paul D. Dougherty, Fred W. Cammann, Jr., Tom O'Connor, George C. Richards.

Super and portable models metal disintegrators

1021 COLONIAL BROACH COMPANY

P. O. Box 37, Harper Station

Detroit 13, Mich.

In Attendance—Arvid Lundell, Ralph Lagerfeldt, Harry Gotberg, Geo. Carr, Chas. Eaton, Jas. Friegel.

Broaching tools, fixtures and gages

426 COMMANDER MANUFACTURING COMPANY

4225 West Kinzie St.

Chicago 24, Ill.

In Attendance—J. B. Chamberlain, L. R. Chamberlain, Frank J. O'Laughlin, Warren Hartman, Joseph F. Mele, John J. Tully, Joseph H. Walter.

Multiple spindle drilling heads, tapper, chip breaker

308 CONOVER MAST PUBLICATIONS, INC.

Mill & Factory—Purchasing—Conover-Mast Purchasing Directory

205 East 42nd St.

New York 17, N. Y.

In Attendance—Harvey Conover, B. P. Mast, Sr., E. M. Stanley, R. A. Gagney, Mead Irwin, G. D. Vosburgh, E. W. Robb, T. P. Murphy, A. M. Morse, Jr., A. G. Graam, R. G. Richards, R. C. Grove.

Mill & Factory, industrial news; *Purchasing*, industrial purchasing; *Conover-Mast Purchasing Directory*

440 CONTINENTAL TOOL WORKS DIV.

(see Ex-Cell-O Corp.)

203 COX ENGINEERING & SALES COMPANY

2046 East Grand Blvd.

Detroit 11, Mich.

In Attendance—M. O. Cox, George Freiman, Robert Lustig.

Freiman automatic trolley conveyor lubricators and portable power tube flaring machine

229 ARTHUR A. CRAFTS COMPANY, INC.

603 Newbury St.

Boston 15, Mass.

In Attendance—Roger H. Huston, Robert W. Sawin, Fred W. Cox, Jr., Standish Rowe, Seth Barraclough, Blaine Webber, Herbert E. Lyster, O. E. Stevens.

Diamond dressers, tools, wheels, compound dust; special and standard carbide and carbide-faced tools and gages

1149 C. C. CRALEY MANUFACTURING CO.

Shillington, Pa.

In Attendance—C. C. Craley, John H. Craley, Clyde E. Craley, Paul W. Craley.

Offset boring heads and accessories

546 F. M. CRAYTON

2024 South Aiken St.

Philadelphia 42, Pa.

In attendance—Foster M. Crayton, Andrew Funk, Thomas Bonner, John Thomas, George Whitton, John Clark, Sr.

T-bolt that cleans the slot

740 CRYSTAL LAKE GRINDERS

19 Gates St.

Crystal Lake, Ill.

In Attendance—Robert H. Kirwin, Mrs. R. H. Kirwin, Paul Burger, Kenneth L. Johnson.

Surface grinders, plain and full universal cylindrical grinders

866 **THE CUSHMAN CHUCK COMPANY**
806 Windsor St.
Hartford 2, Conn.

In Attendance—Harry E. Sloan, Harry E. Sloan, Jr., Harry W. Hultgren, Fred Fippinger, Al Collette, Lin Swanson, Bill Gaw, Jack Lynch, Aubrey Whittemore, Al David, E. G. Boyer, John Way.

Power wrench and index control for spindle machines, air-operated jaw chucks, chucks and cylinders for high spindle speeds, air and wrench-operated chucks

23 **CYCLOID CORPORATION**
112 Newhall Ave.
Saugus, Mass.

In attendance—Emerson T. Oliver, Frank C. Rice.

Spring-master and attachments; coil-master and attachments

1014 **DAKE ENGINE COMPANY**
633 Monroe St.
Grand Haven, Mich.

In attendance—Paul A. Johnson, Jr., James Shaver, Charles N. Jacobson, H. B. Hazerodt.

10-ton utility press; arbor and hydraulic presses; 50-ton die try-out press

412 **DCMT SALES CORPORATION**
164 Duane St.
New York 13, N.Y.

In Attendance—Irwin Lubalin, A. R. Mills, Leonard Carduner, Charles Eisenhardt, Herbert Nevard, Malvin Huff.

Air-operated, high speed small zinc alloy die casting machine

517 **D-S GRINDER DIVISION**
Royal Oak Tool & Machine Company
621 E. Fourth St.
Royal Oak, Mich.

In Attendance—G. H. Mouw, O. W. Dawson, W. G. Mouw, R. B. Luers.

Grinders and radial relief grinding fixtures, chip breaker grinding fixture for tungsten carbide insert bits

850 **DANLY MACHINE SPECIALTIES INC**
2100 S. 52nd Ave.
Chicago 50, Ill.

In Attendance—Kenneth Barber, Robert C. Berggren, Arthur L. Miller, Henry K. Ostrom, Philo H. Danley, George I. Danly, James C. Danly, Vasil Georgeff, Harry M. Appel, Harold J. Staehle, John L. Ongemach, Arthur G. Gullberg, Stewart R. Anstey, Timothy J. Deuby, John W. Hall, Francis T. Wallace.

Die sets and die makers' supplies

230 **DAVIS BORING TOOL DIVISION**
(see Giddings & Lewis Machine Tool Co.)

1058 **deCASTRO & ASSOCIATES**
1517 Santa Fe Ave.
Los Angeles, Calif.

In Attendance—O. F. deCastro, Rosalyn M. deCastro.

Dial index and automatic drill press feeds, collet chucks

429 **DELAWARE TOOL STEEL CORPORATION**
3300 Market St.
Wilmington, Del.

In Attendance—S. N. Levy, Jr., Wm. B. Levy, Richard E. Levy, Fred S. George, T. C. Simpson, J. E. Lutz, Paul Russell.

Heat treating furnaces

1032 **THE DENISON ENGINEERING COMPANY**
1160 Dublin Rd.
Columbus 16, Ohio

In Attendance—K. E. Hopkins, H. F. Levenhagen, H. E. Stein, R. H. Behrend, C. C. Oliver, R. H. Bass, J. M. Gallant, K. C. Binder, F. C. Norris, V. V. Blasutta, F. R. Springer.

Multipresses with accessories, pumps, pressure control and surge damping valves, four-way valve, fluid motors

505 **DETROIT BROACH COMPANY, INC.**
20201 Sherwood
Detroit 34, Mich.

In Attendance—Gustav von Reis, H. R. Conner, D. A. Nelson, J. D. Dustman, Sigge Svenson, J. J. Webb, Cam Morawski, Ray Board, Ed French, Fred C. Ahrendt, Harold Nevin, W. B. Branch, Fred Brazil, Charles A. Brunner, Dave Coletti, J. A. Coletti, R. A. Schulte, J. T. Merriman, John R. Crampton, Ernest A. Isberg, John P. Long, Jack Kelly, Roy Matzen, D. F. Wilkes, R. J. Miller, E. C. Barber, H. T. Schlachter, Robert Strange, A. R. Shevlin, E. P. Harter, W. J. McGennis, G. C. Wood, Frank Pierce, Ralph E. Fisher, Jr.

Variety of broaches and broaching fixtures including "Big Boy", largest manufactured broach

939 **DETROIT POWER SCREWDRIVER COMPANY**

2801 W. Fort St.

Detroit 16, Mich.

In Attendance—R. F. Gladfelter, J. T. Faull, R. L. Breest, P. E. Loomis.

Power driven screwdrivers and nut drivers, selective feeding devices, special assembly machines

321 **DETROIT STAMPING COMPANY FINISHED PRODUCTS DIV.**

350 Midland Ave.

Detroit 3, Mich.

In Attendance—William H. Roberts, George A. Bentley, James A. Gencur, Paul J. Fleming.

Toggle and portable clamps, packaged steel and brass shim stock, feeler gage stock, arbor spacers and shims, blower housings; pressed metal parts, flapper valves

771 **H. E. DICKERMANN MANUFACTURING COMPANY**

321 Albany St.

Springfield, Mass.

In attendance—W. E. Haywood, C. A. Hollister, Jr., Arthur S. Gminski, Harrison Woodford.

Hitch and die feeds; stock reel, height gage; feed mounting adapter

865 **EUGENE DIETZGEN COMPANY, INC.**

218 E. 23rd St.

New York 10, N. Y.

In attendance—W. J. Steller, W. P. Langevoort, A. L. Wankmiller, H. Cope, Jr., R. E. Day

Various types of reproduction and drafting equipment

865 **THE DoALL COMPANY**

254 N. Laurel

Des Plaines, Ill.

In Attendance—W. A. Cole, C. H. Adam, C. C. Clegg, L. I. Liberman, M. A. Singer, G. H. Sheppard, L. R. Rothenberger, C. H. Rosene, J. A. Harrington, H. W. Pottle, J. Spooner, V. Childers, N. Trowbridge, R. Anderson, L. Cruise, J. Nelson, D. A. Moreinis, W. E. Huntley.

Contour and high speed sawing machines, surface grinders, band cutting tools and special measuring instruments

1 **DONOVAN COMPANY**

1615 N. 2nd St.

Philadelphia 22, Pa.

In Attendance—Thos. J. Donovan, Fred Dougherty, Leo Karlberg.

Heat treating equipment; show of tools cleaned by super water blast HydroFinish; display of mechanical driving at any angle without gears

959 **DUMORE COMPANY**

1300 - 17th St.

Racine, Wis.

In Attendance—R. L. Hamilton, J. M. Hamilton, A. E. Owen, J. H. Allen, J. Steible, J. Forrest, J. Barta, Syd Wimpie, Lee Rocke, Gary Bluemink, Fred Orthey, Adolf Orthey, Ernie Bruce.

Drilling equipment, grinding machines, display of new Du-Matic drill head

816 **EASTMAN KODAK COMPANY**

Industrial Optical Sales Division

343 State St.

Rochester 4, N. Y.

In Attendance—Fred N. Hodgson, Robert C. Locker, Claude O. Robinson, Mark W. Purser, Wayne G. Norton, Allen R. Fultz, Robert J. Hudak, Charles F. Cowan, John Kirkebye, Louis Nosco, John Hultberg, Harvey Wilkin, Edward Fox, Walter Litten, Louis D. Martin.

Contour projector and accessories, gear-checking equipment

618 **EDGCOMB STEEL COMPANY**

3600 N. "D" St.

Philadelphia, Pa.

In Attendance—Gustaf Peterson, R. A. Shattuck, O. H. Persons, Stuart B. Mathews, W. L. Gunning.

Tool steel products and carbides

306 **ELGIN NATIONAL WATCH COMPANY**

Industrial Products Division

932 Benton St.

Aurora, Ill.

In Attendance—Edward F. Allen, Dolph Boettler, George E. Boullain, David R. Pennington, Carl Eveler, Larry Phillips, R. L. Guimont, H. Paul Loewenberg, Richard Loewenberg, Harold H. Martin, Maxwell Matthews, W. F. Meehan, R. S. Mechan, E. Y. Moore, H. P. Norris, R. G. Strootman, William Summerbell, R. F. Waindle, W. M. Wochos, J. F. Ireland, T. R. Green.

Abrasive diamond compound; spring alloy and fabricated parts; sapphire wire and thread guides, tipped dial indicator contact points, bearings

303 **ENCO MANUFACTURING COMPANY**

4522-24 W. Fullerton Ave.

Chicago 39, Ill.

In attendance—Nathan Usiskin, Gordon J. Benes, John Barnes, E. H. Appleyard, Milton Corn.

Dial indicators; lathes; flash lights with magnetic base

129 **ENGINEERS SPECIALTIES DIVISION**

of Universal Engraving & Colorplate Company, Inc.

Buffalo 8, N. Y.

In Attendance—Edward C. Polidor, Ernie Bott, John Bernardini, E. A. Isberg, W. DeBoer.

Contour and front surface projectors; chart-gages, staging fixtures for optical comparators and projectors; engineers glass and scales; blade, die and cam shaft checkers

915 **ENGIS EQUIPMENT COMPANY**

411 South Dearborn St.

Chicago 5, Ill.

In Attendance—J. P. Steindler, E. J. Schneider, J. M. Throckmorton, Arnold W. Young, John S. Morton, W. A. Ruppel, T. W. Montgomery, Len Hall, Jack Caswell, Walter R. Hammond, Sam Gleaves, Joseph C. Fletcher, David E. Williams.

Diamond abrasive compounds, optical and mechanical tools and instruments

240 **ERICKSON TOOLS DIVISION**

Erickson Steel Company

2309 Hamilton Ave.

Cleveland 14, Ohio

In Attendance—C. K. Higley, W. H. Eichelman, Frank Winnen, L. M. Lacey, R. G. Butts, H. S. Brandt, E. A. Isberg, Nelson Daily.

Precision holding tools; expanding mandrels; boring and reaming tools, air cylinder; speed indexer

554 **ERRINGTON MECHANICAL LABORATORY, INC.**

24 Norwood Ave.

Staten Island 4, N. Y.

In Attendance—Wm. S. Errington, Stanley A. Errington, Thomas T. Pride.

Tapping, multiple drilling, multiple tapping attachments; die heads, quick change tool holders; stud setters

732 **ETTCO TOOL COMPANY, INC.**

594 Johnson Ave.

Brooklyn 6, N. Y.

In Attendance—Melvin H. Emrick, Robert G. Emrick, Arthur E. Stehle, Louis Irrgang.

Indexing fixtures; tapping machines and attachments; chucks

311 **EVEREDE TOOL COMPANY**

2000 No. Parkside Ave.

Chicago 39, Ill.

In Attendance—John R. Proksa, Arthur J. Proksa, Arthur G. Gutfahr, Walter E. Frank, Roger M. Long, Richard Krause, W. H. Thaxter, Robert L. Towles, R. L. Baker, Don Reep, R. B. Ward, A. F. Irvine, R. L. Guimont, Chester S. Fischer, Andrew C. Graham.

Holders; bits; bars; and boring heads

440 **EX-CELL-O CORPORATION**

Continental Tool Works Division

1200 Oakman Blvd.

Detroit 32, Mich.

In Attendance—Phil Huber, James K. Fulks, Donald H. McIver, Robert W. Ford, Herbert A. Knack, Jack L. Mustard, Arthur E. Schulz, Vincent J. Powers, Frank X. Sweeney.

(Ex-Cell-O) Standard drill jig bushings, precision grinding and boring spindles, precision ball bearings, aircraft and production parts. (Cont. T.W. Div.) Boring bars and tools, broaches and broaching fixtures, drills, reamers, counterbores and sets, milling cutters, hobs and crusher rolls

560 **FALCON TOOL COMPANY**

12502 Greiner Ave.

Detroit 5, Mich.

In Attendance—Ralph A. Edens, Leroy S. Rawson, Cass Prisbe, E. L. Kellow, Henry C. Hook, Fred Harmening, D. E. Flickinger, J. J. Koenig, H. J. Paffenback, T. A. O'Reilly, F. G. Wright.

Taper interchangeable drive; single and double high speed end mills, milling cutters, blue print cutting tool items

305 **FEDERAL PRODUCTS CORPORATION**

1144 Eddy St.

Providence, R. I.

In Attendance—Irving A. Hunt, Louis O. Heinold, Jr., Albert Sanford, Edward Glenn, Kenneth Jarvis, Jack Daub, William Weeks.

Precision measuring instruments including gages, indicators and attachments

651 **FERGUSON MACHINE & TOOL COMPANY, INC.**
471 Paul Ave.
Ferguson Station
St. Louis 21, Mo.

In Attendance—A. G. Hollman, C. N. Neklutin, Philip Gilbert.

Pre-determined electronic counters, intermittent motion mechanism

1143 **FIDELITY TOOL SUPPLY**
309 Vine St.
Camden, N. J.

In Attendance—George W. Powell, M. J. Lonergan, Theodore D. Marshall, Clifford M. Ellis, Walter M. Moore, Robert Halter, Radford Reckard, W. D. Stites, Charles A. Hollister, W. E. Haywood, J. Junkin, Henry D. Gordon, R. J. Pearson, R. E. Reed, Harry Hartwick, Jr., George Feus, H. G. Morander, C. S. Parsons, F. E. Koebel, H. J. Meinert.

Cutting tool accessories and attachments, toolroom accessories

1024 **FIRTH STERLING STEEL & CARBIDE CORPORATION**
McKeesport, Pa.

In Attendance—T. W. Gabriel, N. W. deBerardinis, C. R. Harmon, M. F. Judkins, H. M. Dawson, W. H. Little, W. R. O'Brien, C. O. Averill, H. I. Moore, O. T. Smith, A. W. McCoy, A. J. Davis.

Sintered carbide tools, drawing and blanking dies, Firthite speed drills, tool and die steels

557 **FIRST INDUSTRIAL CORPORATION**
(see Micro Switch Div.)

4 **FLOAT-LOCK CORPORATION**
224 Glenwood Ave.
Bloomfield, N. J.

In attendance—Henry Persson, Tage G. Persson, Kerstin Settman, Harry Janson, C. Arthur Carlson

Safety drill press vise

203 **FLODAR CORPORATION**
331 Frankfort Ave.
Cleveland 13, Ohio

In Attendance—George V. Woodling, Matthew Bauer, Daniel Bauer, M. K. Bauer, V. W. Fauser, Rupert Esser, Don Thomas, John Dale, William J. Battersby, David A. Prentzel, Walter Ellis, Addison T. Smith, Horace E. Thorn, Lloyd G. Wheeler, Thomas H. Paris, M. O. Cox, Paul Bates, Virgil Stofer, William Stofer, J. A. Gachenaul, I. H. Bernard, George Freiman, Robert Lustig.

Hydraulic tube fittings, flare and no-flare type

642 **FOSTER MANUFACTURING COMPANY, INC.**
2850 Gravois Ave.
St. Louis 18, Mo.

In Attendance—John Henry Foster, Elisabeth Foster.

Duplate plastic hose, chrome sleeve quick detachable coupler

631 **THE FRICK-GALLAGHER MANUFACTURING COMPANY**
Wellston, Ohio

In Attendance—J. P. Gallagher, H. J. Geitz, Paul H. Frick, E. L. Forstner, D. P. Forstner, F. A. Frick, H. H. Miller, Eli B. Searle, E. H. Trabold, Allen J. Frick, U. D. Itri, James F. Butler, Jr., H. P. Herr.

Steel storage equipment for tools and stores

936 **THE GAIRING TOOL COMPANY**
21221 Hoover Rd.
Detroit 32, Mich.

In Attendance—E. Gairing, B. O'Meara, D. G. Hawksworth, E. Bemb, Wm. B. McClellan, L. R. Montgomery, F. J. Goddard, A. L. Saull, J. Miller, H. Tuscher, T. Pokorski, Wm. G. Harvey, Wm. G. Harvey, Jr., O. Monahan, C. Sinning, C. P. Morgan, J. W. Mull, Jr., Chas. Peterson, Ted Meyer, R. Thompson, F. H. Robertson, B. L. Powell, F. Snyder, C. B. Cole, Buell Manning, Walter F. Cahill, R. Williams, E. Byro, J. Nymberg, I. M. Wright, J. Armstrong, K. Jones, E. H. Josephi, B. L. Schmidt, J. T. Norris, Jr., W. Cebelinski.

Mills, boring bars, cutters and cutter blocks, counter-bores and sets.

844 **GALLAND-HENNING MANUFACTURING COMPANY**
NOPAK DIV.
2753 S. 31st St.
Milwaukee 15, Wis.

In Attendance—J. D. Harshaw, R. W. Peterman, H. A. Nunnemacher.

Air and hydraulic valves and cylinders

31 **THE GAMMONS-HOAGLUND COMPANY**
395 Main St.
Manchester, Conn.

In Attendance—Marion Gammons Fitch, Marion Avery Fitch, C. Arthur Hoaglund, Fred Hanson, C. W. Keeney, David Addy.

Reamers and end mills

Products Listings on page 86

537 **GENERAL ANILINE AND FILM CORPORATION**
(see Ozalid, Div. of)

655 **GEROTOR MAY CORPORATION**
Maryland Ave. and Oliver St.
Baltimore 3, Md.

In Attendance—E. E. Yaggy, Jr., C. R. Collins, E. Wandrey, A. G. Winchester, B. J. Quintilian, H. A. Sevier, S. J. Hardesty.

Hydraulic pumps and fluid motors

230 **GIDDINGS & LEWIS MACHINE TOOL COMPANY**
Davis Boring Tool Division
142 Doty St.
Fond du Lac, Wis.

In Attendance—John H. Daum, Donald M. Laflin, E. J. Kaiser, Harry C. Soukup, Milton Kuhn, Vern Unger, A. A. Straum, G. E. Lingenfelter, Harold L. Johnson, Milton Nichols, L. L. Peeke, H. S. Peters, S. L. Little.

Micrometer stud boring tool sets, boring and turning mill tools, inserted blade adjustable reamers

748 **L. H. GILMER COMPANY**
Division of United States Rubber Company
Tacony, Philadelphia 35, Pa.

In attendance—H. B. Allison, E. F. Wood, H. W. Weihenmayer, R. Y. Case, R. E. Bruce, H. R. Chapman, L. V. Clifford, W. H. Pross, H. K. Reed, T. E. Smith, W. H. Taylor, P. M. Wright, R. M. Katzenberger, C. G. Butler, D. J. Ganley, E. R. Evans.

Timing, special purpose endless and V-belts

1108 **GODDARD & GODDARD COMPANY**
12280 Burt Rd.
Detroit 23, Mich.

In Attendance—E. A. Goddard, L. H. Goddard, S. H. Grattan, I. H. Bartling, W. Kinden, G. Marshall, A. H. Anderson, C. A. Clauss, J. A. Coletti, K. H. Crosby, C. W. Davidson, J. M. Delaney, G. H. Diers, E. G. Doran, J. Dorjath, J. A. Greenwald, J. W. Kelly, H. F. Miller, C. W. Moore, J. S. Murray, B. Murray, C. D. Proctor, J. F. Sample, T. H. Wallace.

Milling cutters—new serratip line, solid high-speed steel, carbide and cast alloy

1155 **THE GOVRO-NELSON COMPANY**
1931 Antoinette St.
Detroit 8, Mich.

In Attendance—O. R. Aronson, C. E. Broders, F. L. Haggard, John Wilcox, Lester Wilcox, George Weber, W. B. Baker, Frank Pugsley, C. A. Wales, C. D. Proctor, C. A. Clauss, M. H. Huth.

Automatic drilling and tapping units

672 **GRAHAM MANUFACTURING CORPORATION**
1541 E. Eight Mile Rd.
Ferndale 20, Mich.

In attendance—Jack Nater, T. L. Hufert, H. J. Graham, P. E. Powder, A. Stewart, F. E. Hall, R. Graham, C. Graham, A. Monson, M. R. Liles, L. D. T. Berg, T. C. FitzGibbon, W. L. Fisher, E. O. Larson.

Stud welder

1044 **GRAHAM-MINTEL INSTRUMENT COMPANY**
2443 Prospect Ave.
Cleveland 15, Ohio

In Attendance—Walter O. Mintel, Erwin W. Graham, Wayne G. Klager, Richard E. Roeger.

Electronic measuring instruments

765 **GREAT WESTERN TOOLS INC.**
3811 W. Riverside Dr.
Burbank, Calif.

In Attendance—Robert G. Bodtke, John H. Armstrong, H. B. Armstrong, George H. McClennen.

Automatic air feeds for punch presses, drill presses, spot welders

1112 **GRIFFITH-RAGUSE & COMPANY, INC.**
3015 Fox St.
Philadelphia 32, Pa.

In Attendance—W. J. Griffith, P. E. Raguse, Robert W. Griffith, William C. Chalfont, Joe Rebl, Michael Maguire, Edward Yates.

Metal cutting saws, electric power tools, sanding machines, grinding wheels, abrasives, grains and powders, wire brushes and industrial diamond tools

562 **F. T. GRISWOLD MANUFACTURING COMPANY**
305 W. Lancaster Ave.
Wayne, Pa.

In Attendance—Frank T. Griswold, Jr., Francis Lieber, D. C. Radcliffe, Richard Minnich, Howard Hanna, Margaret M. Gordon.

Dividing head, rotary table, measuring devices

Products Listings on page 86

153 **GROBET FILE COMPANY OF AMERICA, INC.**

421 Canal St.

New York 13, N. Y.

In attendance—J. M. Robert, R. P. Galli, Charles Lender, Henry Giebel, Leo J. Hinchey.

Countersinks, cutting and forming tools, files

615 **GULF OIL COMPANY**

Gulf Bldg.

Pittsburgh 30, Pa.

In Attendance—E. G. Williams, O. F. Shaver, J. Marshall, Jr., R. E. Dart, F. C. Robert, A. L. Sears, A. T. Barclay.

Hydraulic and cutting oils, lubricants, rust preventives

713 **HAMILTON MANUFACTURING COMPANY**

Two Rivers, Wis.

In Attendance—J. G. Embury, H. R. Morris, R. M. Giblin, R. E. Klinkner.

Blue print files and drawing tables

725 **HAMMOND MACHINERY BUILDERS, INC.**

1600 Douglas Ave.

Kalamazoo, Mich.

In Attendance—S. H. Miller, H. J. Kingsbury, R. M. Bell, A. L. Perkins.

Grinders and grinding fixtures

1164 **HANCHETT MAGNA-LOCK CORPORATION**

P. O. Box 816T

Big Rapids, Mich.

In Attendance—Dayton D. Stone, Charles W. Adkins, Wayne Knopf, J. F. Manting.

Magnetic chucks, parallels, and clamps for holding non-magnetic materials

607 **HANDY & HARMAN**

82 Fulton St.

New York 7, N. Y.

In Attendance—J. W. Colgan, M. W. Townsend, A. M. Setapen, J. C. Powers, Jr., V. T. Vans Syckel, G. Van Haste, A. W. Swift, R. T. Jones, P. L. Heding, D. A. Kimber, W. G. Weber.

Silver brazing alloys

772 **HANNA ENGINEERING WORKS**

1765 Elston Ave.

Chicago 22, Ill.

In Attendance—A. F. Jensen, J. C. Hanna, E. L. Foster, J. A. Kasper, F. A. James, J. Boyd Coates, C. E. Casper, F. Lobb, Jr., W. A. Peters, W. M. Dubin.

Hydraulic and pneumatic cylinders and valves

215 **HANNIFIN CORPORATION**

1119 South Kilbourn Ave.

Chicago 24, Ill.

In Attendance—E. G. Peterson, H. H. Adams, O. J. Maha, L. S. Ohman, G. O. Hendee, D. G. Henderson, R. E. Hitchcock, W. T. Brookins.

Cylinders, valves, filters, pressure regulators and lubricators

701 **HARDINGE BROTHERS, INC.**

1420 College Ave.

Elmira, N. Y.

In Attendanec—D. G. Anderson, D. R. Laux, J. S. McCarty, E. A. Iverson, H. A. Lundy, J. R. O'Connell, D. W. Strom, H. J. Parsons, J. J. Kearney, P. E. Chatelain, W. F. Jones, A. C. Lormore, J. B. Mack, E. G. German, W. C. Haskins, J. D. Livens, J. W. Pedalty, R. L. Hazel, L. H. Reily, J. J. Droleski, L. S. Sutoski, H. J. Hoy, W. T. Harvey, C. C. Murray.

Circular forms and cut-off tools, collet index fixtures, step chucks and nose type speed collet chucks, master collets and pads, feed finger and pads

835 **HARDINGE BROTHERS, INC.**

1420 College Ave.

Elmira, N. Y.

In Attendance—Same as above.

High speed tool room and precision lathes, milling machines, and accessories, chucking and second operation machines, hand screw machines with bar feed

838 **HAUSER MACHINE TOOL CORPORATION**

30 Park Ave.

Manhasset, L. I., N. Y.

In Attendance—Carl Hirschmann, Robert Hofmann, Andre Sieber, James E. Kerez, Richard Krause, Richard Krause, Jr., Walter S. Ryan, John Berlin, Gilbert Dannehower, Jean Berger, Hans Forrer, Paul Chatelain, S. A. Clark, R. B. McBeth.

Jig boring and grinding machines; measuring machines; polishing and hardness tester machines: precision lathes and milling machine, cutter; screw machine, gear hobbing machine

509 **HAYNES STELLITE DIVISION**

Union Carbide and Carbon Corporation

725 S. Lindsay St.

Kokomo, Ind.

In Attendance—E. E. LeVan, R. L. Lerch, A. V. Harris, Arthur Gray, W. J. Lindner, C. D. Hartnell, E. P. Kelly, H. N. Cuson, F. A. Routa, G. R. Barrow, R. B. Hotchkiss, F. T. McCurdy, F. B. Sills, J. W. Todd, J. P. Reap.

Metal cutting tools, precision castings, special parts, hard facing alloys, also high temperature and corrosion resistant alloys

559 **THE HEIM COMPANY**

46 Sanford St.

Fairfield, Conn.

In Attendance—Charles R. Heim, R. F. W. Smith, A. R. McCloskey, L. R. Heim, Carl C. Van Etten.

Bearings, sweepsticks and mounted units

1002 **HEINTZ MANUFACTURING COMPANY**

Philadelphia 20, Pa.

In Attendance—L. A. Passmore, Jr., V. C. Gorman, H. F. Faunce, J. S. Carter, J. M. Ward, W. C. DeMaris.

Stampings, television base die, home appliances, refrigerator evaporator, jet engine combustion chamber, tail cone, transition liner

THE HERMAN STONE COMPANY

324 Harries Bldg.

Dayton 2, Ohio

In attendance—R. A. Mayne, Robert Porter, Harry Berkshire, Richard Broerman, W. J. Fors, Larry Hammond, L. E. Nelson, Axel Olson, R. F. Turner, Lester Wilcox.

Granite surface plates, straight edges, spotting plates

114 **HEUBNER PUBLICATIONS**

(see Tool & Die Journal)

548 **HITCHCOCK PUBLISHING COMPANY**

Machine and Tool Blue Book

222 East Willow Ave.

Wheaton, Ill.

In Attendace—Vincent C. Hogren, Jay Tuthill, Alvin E. Wailes, Dan Reardon, Raymond J. Sietsema, Henry J. Smith, John A. Wright.

Machine and Tool Blue Book
Market data information on the metalworking industry, and export sales catalogs (in Spanish and Portuguese, as well as English). *Hitchcock's Export Sales Catalogs*, listings and descriptions of equipment for export

951 **HY-AIR PRODUCTS COMPANY**

P. O. Box 5

Jackson, Mich.

In Attendance—Philip L. Reynolds, Leonard R. Beck.

Automatic air-operated oil hydraulic press

1159 **HY-PRO TOOL COMPANY**

461 Mt. Pleasant St.

New Bedford, Mass.

In Attendance—H. F. Phipard, F. K. Brown, F. T. Thorley, R. A. Smith.

Special tools; standard and special high speed steel ground thread taps

1048 **IDEAL INDUSTRIES, INC.**

Park and Borden Ave.

Sycamore, Ill.

In Attendance—J. W. Richardson, Robert Paul, T. W. Becker, Jr., Gordon B. Koch, M. A. Buettell, John M. Elliott.

Live lathe centers, electric etchers, copper head locks, abrasive sticks, demagnetizers, electric blowers, soldering tools

756 **ILLINOIS TOOL WORKS**

2501 N. Keeler Ave.

Chicago 39, Ill.

In Attendance—E. E. Valy, R. E. Wolff, Raymond Blakeman, R. E. Leiner, C. W. Enstrom, E. W. Hollingsworth, D. J. Heckinger, R. M. Wall.

Hobs, broaches, cutters, form tools, gage measuring machines

1115 **INDEX MACHINE COMPANY**

543 N. Mechanic St.

Jackson, Mich.

In Attendance—Guy S. Adams, Herbert T. Andress, Frank H. Child, John Flanagan, Harry Bass, J. Erney.

Horizontal and vertical milling machines with accessories and attachments, precision rotary tables and indexing attachments

1071 **INDUSTRIAL DIAMOND ASSOCIATION OF AMERICA, INC.**

124 East 40th St.

New York 16, N. Y.

In Attendance—Athos D. Leveridge, Therese Leveridge.

Diamond saws, dies, dressing and truing, contour forming tools, wheels, core bits, turning and boring tools, special use items

01 **THE INDUSTRIAL PRESS**
(see Machinery Magazine)

306 **INDUSTRIAL PRODUCTS DIVISION**
(see Elgin National Watch Co.)

34 **INDUSTRIAL SCIENTIFIC COMPANY**
34 W. 33rd St.
New York 1, N. Y.

In Attendance—William S. Tandler.

Probograph automatic contour measuring instrument, photographic displays

950 **INGERSOLL MILLING MACHINE COMPANY**
Douglas & Willoughby Ave.
Rockford, Ill.

In Attendance—George P. Torrence, Karl B. Kaiser, H. A. Loy, Wm. F. Johnson, Jr., John E. Carlson, R. R. Langlois, D. L. S. McCoy, C. C. Leach, D. G. Brophy, Harold Love.

Inserted blade milling and boring cutters high speed steel, cast alloy, carbide tipped blades

552 **INSTITUTE OF INDUSTRIAL LAUNDERERS, INC.**
3517 W. Harrison St.
Chicago 24, Ill.

In Attendance—Sidney Stark, Howard Humphrey, John J. Roche, Roy Hoge, Bruce Renard, Dennis Devins, Edward V. Earl, Thomas M. O'Brien, Frank S. Abel.

Industrial towels and work clothes

210 **THE IRON AGE**
100 East 42nd St.
New York 17, N. Y.

In Attendance—George T. Hook, Jack R. Hight, J. M. Spackman, B. L. Herman, R. F. Blair, Paul Bachman, Peirce Lewis, Jos. S. Hildreth, O. L. Johnson, B. H. Hayes, C. T. Post, C. H. Ober, Stanley J. Smith, M. U. Chittenden, Tom Campbell, W. V. Packard, T. E. Lloyd, G. F. Sullivan, D. I. Brown, F. J. Winters, Stephen Baur, W. Czygan, E. C. Beaudet, John Anthony.

The Iron Age magazine on metalworking industry news; reprints

Products Listings Begin on page 86

954 **J & S TOOL COMPANY, INC.**
477-P Main St.
East Orange, N. J.

In Attendance—Henry F. Swenson, Gary K. Ovargaard, J. Howard Kennedy, Clifford C. Baker, Henry Hawkinson, Katherine Hall.

Machine table accessories, boring and turning tools, wheel dressers, "form-grinding" service

671 **THE JACOBS MANUFACTURING COMPANY**
West Hartford 10, Conn.

In Attendance—A. M. Stoner, A. E. Englund, F. L. McCarthy, R. A. Clark, A. L. Stevenson, W. R. Barlow, D. E. Duffy, E. B. Chamberlin, W. Page Wodell, Jack Priest, S. D. Conant, G. S. Haviland.

Spindle nose lathe collet chuck, drill, super and tap chucks, collets

1036 **JANNEY CYLINDER COMPANY**
7425 State Rd.
Philadelphia 36, Pa.

In Attendance—J. B. Janney, Philip P. Jefferis, M. C. Johnson, V. J. Goffredo, J. B. Downing, E. J. Hubbard, M. H. Sorensen.

Diesel cylinder and pump and compressor liners and other machined products from centrifugal castings

807 **CHAS. L. JARVIS COMPANY**
Middletown, Conn.

In Attendance—R. Wetzel, Wm. F. Jarvis, Martin H. Buehler, 2nd, George Garwood, John Lambert, Harry Paton, Henry Gotta, Al Landry, Gerald H. Buker, Wm. G. Shaw, Ira M. Savage, J. J. Kelly, Frank DeLucia, Don Campbell, George Gundersdorf, Kendall Hastings, Edw. Day Harris, Lawrence Phillips.

Drilling and tapping equipment and accessories

112 **JERGENS TOOL SPECIALTY COMPANY**
712 E. 163rd St.
Cleveland 10, Ohio

In Attendance—Jack H. Schron, Jay F. Capes, Jr., J. W. H. Jensen.

Jig and fixture components, clamps, soft chuck jaw blanks, hand tools, sine fixture key

1051 **JOHNSON GAGE COMPANY**
534 Cottage Grove Rd.
Bloomfield, Conn.

In Attendance—Stanley G. Johnson, Paul W. Johnson, Clinton V. Johnson.

Thread gages and comparators, screw thread analyzers, thread plug gages

831 **JONES & LAMSON MACHINE COMPANY**
160 Clinton St.
Springfield, Vt.

In Attendance—Harold L. Murch, J. A. Allen, A. J. Gebow, L. E. Bernardini, R. W. Brown, K. G. Cady, E. S. Jefferies, G. F. Bickford, E. H. Wells, R. M. Jacobs, R. R. Finn, R. O. Beardsley, J. C. Hebert, E. W. Simonds, R. H. Streeter, W. Sinawski, R. H. Dressel, F. MacArthur, J. E. Lovely, L. M. Davis, L. E. Fuller, G. R. Morin, E. V. Flanders, H. H. Whitmore, W. J. Grimm, R. V. MacKenzie, C. A. Johnson, E. C. Morse, W. H. Hinchliffe, L. W. Copeland, A. L. Currie, H. F. Holden, G. M. Tarbell, J. H. Johnson, F. E. Cheever, J. R. Knights.

Optical comparators and measuring machines and accessories, stationary and revolving die heads, ground thread chasers, chaser sharpening machines, carbide cutting tools

1012 **KALAMAZOO TANK & SILO COMPANY**
Machine Tool Division
508 Harrison St.
Kalamazoo 16, Mich.

In Attendance—Morey H. Ruvin, Wm. Washburne, H. B. Hazerodt, R. W. Elsbey, J. M. Coombs.

Metal cutting band saw machines

1120 **KAUFMAN MANUFACTURING COMPANY**
547 So. 29th St.
Manitowoc, Wis.

In Attendance—L. J. Kaufman, W. J. Cihlar, C. H. Shemchak, R. F. Dornaus.

Lead screw tapping machine with two-spindle multiple head and automatic indexing fixture. Also various component parts of the machine

105 **KEARNEY & TRECKER CORPORATION**
(see Walker-Turner Div.)

632 **KELLERFLEX DEPARTMENT**
Pratt & Whitney Division
Niles-Bement-Pond Company
Charter Oak Blvd.
West Hartford 1, Conn.

In Attendance—C. E. Smith, S. K. Coates, F. O. Hoagland, L. J. Feeley, John Ciszek, E. Dyjak, John Conlon, D. C. Fuller, Boyd Nixon, T. J. Boyd, V. Wadlund.

Shaft machines; carbide burs; wheel forming attachment; shaping grinding wheels and grinding forms

914 **KENNAMETAL INC.**
Lloyd Ave.
Latrobe, Pa.

In Attendance—P. M. McKenna, A. G. McKenna, W. D. Turnbull, W. L. Kennicott, G. A. Bunn, Bennett Burgoon, L. W. Guild, G. J. Raible, R. B. Weeks, C. M. Wheelock, G. O. Bogner, J. G. Brandy, F. L. Brugger, W. A. Mester, C. R. Miller, R. H. Oberholtzer, H. A. Pilling, R. S. Sagers, G. E. Smith, L. K. Weeks, E. P. Weiland, F. W. Pennington, S. J. Repko, Fred Hennig.

Clamped-on and conventional brazed tools; mills; wear resistant elements; balls for hole sizing; strip mill rolls; disc files; saws for wood and plastics; router bits; titanium alloy

1161 **LAST WORD SALES & ENGINEERING COMPANY**
Box 287
Royal Oak, Mich.

In Attendance—E. V. Statia, E. L. Chapman, Robert Grimes, E. J. Albrecht, Mrs. E. L. Chapman, H. E. Hofferberth.

Angle tangent to radius wheel dressers

556 **LASSY TOOL COMPANY**
92 Bohemia St.
Plainville, Conn.

In attendance—Carl O. Lassy, Ellis Bardsley, J. Bauer, Charles Yerger, P. Robbins, Robert Hulteen.

Tapping machines and accessories, toolroom accessories

808 **LATROBE ELECTRIC STEEL COMPANY**
2626 S. Ligonier St.
Latrobe, Pa.

In Attendance—M. W. Saxman, Jr., J. E. Workman, Dr. S. G. Fletcher, R. P. Kells, W. G. Kuntz, J. W. Hall, D. P. Hughes, G. W. Frick, M. W. Saxman, III, R. S. Rose, R. C. Kohl, F. E. Allison, H. C. Burgess, R. C. Smith, J. H. Dodge, H. C. Cole, J. Pfaff, J. C. Bigham, J. E. Preas, C. W. Barnthouse, J. R. Larson, T. G. Lynch, L. M. Teich, W. J. Lohmeyer, A. G. Barnes, W. J. Kennelly, J. K. Barker, W. G. Dahl, A. J. Woods, F. E. Herr

Polished and etched inspection discs, high speed steels, high-carbon high-chromium die steel, alloy tool and die steels, high vanadium die steel

566 **K. O. LEE COMPANY**
Congress at First
Aberdeen, South Dakota

In Attendance—Don Lyons, C. C. Lee, Dale Lee, Ted Hunstad, Don Stablein, John J. Corper, Ed. Johnson, Jerry Huber, Pat Stone, Mike Samuels, Wm. A. Smith, Bart D. Foley, Ian Mackey, Jerry Huber.

Grinders and fixtures, hone and reamer drives, reamers, mandrels, welders, drill chucks, wheel dressers, drills, sanders, polishers

721 LINK-BELT COMPANY
307 N. Michigan Ave.
Chicago 1, Ill.

In Attendance—R. B. Holmes, D. H. Renfrew, J. H. Oakes, R. W. Suman, G. L. Gansz, P. C. Smith, C. E. Williams, R. C. Haldeman, R. M. Bowman, C. F. Hey, E. C. Epstein, Eric Lund, E. E. Grossweiler, F. P. Schell, R. T. Young, Jr., Wm. Reichenbach, Wm. Dietrich, W. L. Hartley, B. K. Hartman, W. J. Nighbert, A. C. Fellinger, A. H. Boike, Harry C. Porter, J. C. Andrews, H. K. Thum, William Palmer, L. E. Thom. J. Amato, W. Baran, J. Blanchard, H. Clopp, H. F. Sweeney, G. C. Clark.

Variable speed drive, and electrofluid drive, silent and roller chains, anti-friction bearings

115 LIPE-ROLLWAY CORPORATION
806 Emerson Ave.
Syracuse 1, N. Y.

In Attendance—E. S. Mariotte, R. D. Spier, P. T. Klix, B. C. Harney, H. R. Wuilliez, J. Lanphere.

Portable power hack saw machine, automatic magazine loading pneumatic bar feed, pneumatic bar feed (standard)

6 F. J. LITTELL MACHINE COMPANY
4127 N. Ravenswood Ave.
Chicago 13, Ill.

In attendance—F. M. Littell, W. J. Littell, J. P. Monell, C. E. Monell, C. F. Netzler, R. E. Miller.

Automatic feeds for punch presses, air valves

11 LIVINGSTONE ENGINEERING COMPANY
100 Grove St.
Worcester 5, Mass.

In attendance—Bradley C. Higgins, Frederick J. Riker, Jack Waldrop, R. Whitney Higgins, Frank M. Painter, H. Conrey, Chad Millar.

Steam cleaning equipment

1045 LOGAN ENGINEERING COMPANY
4901 W. Lawrence Ave.
Chicago 30, Ill.

In Attendance—L. H. Fenwick, Richard Lull, Henry Hume, Harry Peterson, George Ericksen, Larry Conroy.

Turret & engine lathes, shaper

707 LOGANSPORT MACHINE COMPANY, INC.
Logansport, Ind.

In Attendance—E. P. Wilkinson, C. M. Bates, L. R. Burger, W. A. Smith, Hayiland Wright, Harald H. Gade, D. E. Flickinger, H. J. Paffenbach, T. A. O'Reilly, J. J. Koenig, F. G. Wright.

Air and hydraulic cylinders, valves, arbor presses and chucks, centrifugal pumps, hydraulic power units

646 LOVEJOY TOOL COMPANY, INC.
Main St.
Springfield, Vt.

In Attendance—C. Jenness Cameron, Don H. Proctor, Don E. Rice, Gerry T. Attridge, W. H. Jones.

Inserted tooth cutter, face mills, side mills and grooving mills; end mills and adaptors; adaptor arbors, flywheels; blades for all Lovejoy products

508 THE LUFKIN RULE COMPANY
1730 Hess St.
Saginaw, Mich.

In Attendance—R. M. Benjamin, G. R. Carpenter, Andrew Kirr, R. A. Maitland, E. H. Meibeyer, C. J. Peterson, O. M. Reader, W. F. Rockwell, W. S. Speir, Wm. E. Tufts.

Precision tools; measuring tapes and rules

1072 EDWARD A. LYNCH MACHINERY COMPANY
29 E. Wynnewood Rd.
Wynnewood, Pa.

In Attendance—Edward A. Lynch, Robert L. Rachor, Andrew H. Kean, Arthur B. Carey, Daniel J. Stevenson, John A. McMonagle, J. A. Schaefer, J. I. Andersen, A. Muranko, J. J. McGlone, R. A. West, T. J. Kelleher, Walter Dries, A. J. DeWolf, M. A. Libert, W. H. Perry, C. H. Bentley, W. M. Baker, E. Delaney, J. Owen Munroe.

Power press brake and press brake dies; hi-speed shear; plate and sheet forming rolls; combination punch, shear, and coper; stamping trimmer

642 M-B PRODUCTS
130-134 E. Larned St.
Detroit 26, Mich.

In Attendance—Waldo F. Congdon, J. A. Monnier, Irving Manheimer, Glenn A. Harwood.

Portable pneumatic grinders, automatic air line filters, lubricators and pressure reducing and regulating valves

101 MACHINERY
Industrial Press, Publishers
148 Lafayette St.
New York 13, N. Y.

In Attendance—R. B. Luchars, E. A. Becker, C. O. Herb, H. L. Horton, H. L. Gray, S. E. Larson, G. H. Buehler, Boyce Tope, W. E. Robinson, Dwight Cook, R. D. Mayberry, L. G. Hammerschlag, C. I. Sommer, Charles Wick, George DeGroat, W. Walters, R. A. Weitzel.

Machinery, news in machine industry; trade papers and engineering books

548 MACHINE AND TOOL BLUE BOOK
(see Hithchcock Publishing Co.)

1012 **MACHINE TOOL DIVISION**

(see Kalamazoo Tank & Silo Co.)

943 **MACKLIN COMPANY**

2914 Wildwood Rd.

Jackson, Mich.

In Attendance—Robert Apted, Ted O'Connell, M. T. Hunt, L. L. Marra, L. H. Brune.

Grinding wheels for tool rooms

513 **MADISON MANUFACTURING COMPANY**

1713 Seventh St.

Muskegon, Mich.

In Attendance—Willard Bierema, Clarence Vanderlinde, S. A. Veltman, H. F. Wulf, Robert Severance, E. Hassig, H. B. Morrison, W. B. Ensley, Nelson Church, E. M. Benson, J. A. Mann, E. H. Meehan, S. F. Brandt, John Cochran.

Rough boring tools, reaming tools, boreamers, grinding fixtures

563 **MAGNAFLUX CORPORATION**

5900 Northwest Hwy.

Chicago 31, Ill.

In Attendance—Keith Van Kirk, H. Migel, A. K. Saltis, H. G. Bogart, R. S. Peterson, Donald Smith, W. D. Reid, Jr.

Inspection equipment, powders and pastes

1147 **MARTINDALE ELECTRIC COMPANY**

1347 Hird Ave.

Cleveland 7, Ohio

In Attendance—Roy E. Blersch, Florence Blersch.

Rotary burrs and files; circular metal-cutting saws; flexible shaft machines; mica undercutters and undercutting saws; electrical testing instruments; protective dust masks

1010 **MARVIN MACHINE PRODUCTS, INC.**

414 Ford Bldg.

615 Griswold St.

Detroit 26, Mich.

In Attendance—H. B. Hazerodt, James W. Roberts, Harry Roberts, B. G. Russelo, M. E. Gilman, E. G. Cormany, Wm. Hying.

Vertical mill attachment, rotary index table, dividing head, slotting attachment, micrometer boring head

551 **THE McCASKEY REGISTER COMPANY**

Industrial Division

Alliance, Ohio

In Attendance—F. E. Henry, III, C. Swoboda, David Cameron, H. J. Ellington, P. W. Lowe, G. A. Reynolds, C. E. Taylor, F. E. West, W. A. Young.

Industrial control systems, visible filing equipment, envelopes for shop papers

416 **McGRAW-HILL PUBLISHING COMPANY, INC.**

(see American Machinist)

1160 **THE METAL REMOVAL COMPANY**

1014 N. Ashland Ave.

Chicago 22, Ill.

In Attendance—Charles E. Davis, Donald M. Wetherald, W. W. Cady, W. W. Cady, Jr., Bertram Chayes, A. C. Hanson, R. L. Slaughter.

Porcelain bonded mounted wheels and points; carbide burrs and rotary files; die finishing specialties; carbide grinders

558 **METAL-WORKING**

Sutton Publishing Co., Inc.

60 East 42nd St.

New York 17, N. Y.

In attendance—L. W. Collins, Glenn Sutton, R. A. Neubauer, F. H. Story, R. E. Cleary, I. A. Lesher, L. C. Davis.

Metal-Working, product news and pictures for metal-working industry

22 **W. F. MEYERS COMPANY**

1017 14th St.

Bedford, Ind.

In attendance—V. A. T. Albright, W. V. Albright, Ingolf Sneva, R. L. Quackenbush.

Carbide inserted drill jig bushing, carbide tipped saws

1017 **MICHIGAN TOOL COMPANY**

7171 E. McNichols Rd.

Detroit 12, Mich.

In Attendance—M. R. Anderson, C. R. Staub, P. F. Zerkle, C. E. Eaton, B. Bumsted, J. Friegel.

Gear cutting tools

557 MICRO SWITCH

Freeport, Ill.

In Attendance—J. K. Lincoln, K. J. Cumming, G. G. Boyle, J. A. Thoerle, C. T. Morison.

Precision and limit switches

520 MICROCAST DIVISION

Austenal Laboratories, Inc.

224 E. 39th St.

New York 16, N. Y.

In Attendance—J. J. Erdmann, R. L. Wiseman, A. W. Merrick, C. P. Brooks, W. W. Troupp, E. L. White, J. H. Ritter, C. F. Bower, J. M. Uhle, R. Svensk, F. J. Comerford, G. A. Greenamyer.

Microcasts of various metals

308 MILL AND FACTORY

(see Conover Mast Publications, Inc.)

735 MILLER MOTOR COMPANY

4027 N. Kedzie Ave.

Chicago 18, Ill.

In Attendance—Frank Flick, J. L. Modrich, R. H. Grand, Lesley Colliflower, W. S. Gibson, Joe Clancy, K. C. Mosier, C. H. Ribble, H. O. Meyer, M. G. Saake, Lester Menken.

Air and hydraulic cylinders; fluid pressure boosters; air hoists

405 A. MILNE & COMPANY

745 Washington St.

New York 14, N. Y.

In Attendance—H. S. Hoyt, J. King Hoyt, Jr., H. M. Benham, J. M. Smith, W. F. Goetz, C. C. Pinkney, F. D. Illingworth, H. S. Hoyt, Jr., E. Wenner.

Dies and products of dies made from various types of tool steels

619 MILTON EQUIPMENT COMPANY

N. E. Cor. 4th & Race St.

Philadelphia 6, Pa.

In Attendance—Milton Fine, J. Wm. Feldmayer, John J. Feldmayer, Wm. J. Kelly, Mrs. C. Gross.

Steel brake, punches and shears, tools and machinery, nibbler, slip roll formers

30 MODERN INDUSTRIAL ENGINEERING COMPANY

14230 Birwood Ave.

Detroit 4, Mich.

In attendance—William H. Bibbens, Ellsworth M. Stay, Paul Hacker.

Gear burring and chamfering machines

1111 MODERN MACHINE SHOP

Gardner Publications

431 Main St.

Cincinnati 2, Ohio

In Attendance—Howard Campbell, Fred W. Vogel, Granville M. Fillmore, John M. Krings, Richard S. Kline, George E. Hay, Charles H. Deily Jr., Gene J. Schwarber.

Modern Machine Shop, machine and metal working news

957 MODERNAIR CORPORATION

4222 Hollis St.

Oakland 8, Calif.

In Attendance—John E. Goldring, Donald E. Daniel, G. L. Sandersen, David A. Prentzel, Horace E. Thorn, Lloyd G. Wheeler, Addison Smith, Walter Ellis, Norman Roden, Arthur Jarrett, Lew Lees.

Control valves, cylinders, machine tool feeding units, presses, collet closing fixtures, hydraulic pumping units, quick exhausting valves (all air operated)

1053 MONTGOMERY MACHINE TOOL ACCESSORIES

53 Park Place

New York 7, N. Y.

In Attendance—Myron Halpern, Albert B. Hanson.

Collet type dividing head and attachments, production marking tool, inspection devices, tool room setup appliances, hand spring winder

301 MOORE PRODUCTS COMPANY

H & Lycoming Sts.

Philadelphia 24, Pa.

In Attendance—Charles H. Thompson, James E. Gambrill, Edmund D. Bachand, J. J. Fergeau, Warren Jensen, H. S. Garrett, C. B. Moore, Richard Hopkins, Eugene C. Moore, Jr.

Pneumatic comparator gages, pressure regulators, air filters

1007 **MOORE SPECIAL TOOL COMPANY, INC.**
740 Union Ave.
Bridgeport 7, Conn.

In Attendance—Edward Shaw, Sr., Carl O. Larson, George M. Lamb, Fred E. Jennings, R. H. Cunningham, Jr., Richard L. Parnoff, O. P. Brett, E. J. Albrecht, W. S. Dvorak, E. C. Shafer, Jim Parks, E. W. Spear, B. F. Simmons, W. D. Angell, F. C. Victory.

Precision jig borer, jig grinder, wheel dresser, hole location accessories

437 **MORTON MACHINE WORKS**
2421 Wolcott St.
Ferndale 20, Mich.

In Attendance—Arch Morton, F. H. Robertson, Frank Snyder, Robert E. Powell, Fred Guite, Ralph Schirmer, Tony Gorsky, R. L. Scott, J. L. Hyland, G. T. Osborne, M. R. Clark.

Jig and fixture accessories, machine table accessories

639 **MUELLER ENGINEERING COMPANY**
3331 Greenfield Rd.
Dearborn, Mich.

In attendance—Otto Mueller, Betty Sudz.

Hydraulic press, interchangeable punches, pressure selector valve, fluid connectors, perforating and riveting machines

601 **NATIONAL BROACH & MACHINE COMPANY**
5600 St. Jean
Detroit 13, Mich.

In Attendance—W. S. Praeg, J. I. Schultz, M. B. Mentley, B. F. Bregi, H. Ashton, T. S. Gates, D. P. Smith, L. B. Alliason, A. Forberg, J. Psenka, C. Clinton, J. Byce.

Gear checking machines, sound testing machines, rolling fixture and shaving cutters; broaches and broached parts

1162 **NATIONAL JET COMPANY**
Cumberland, Md.

In attendance—Howard Williams, Galen Metzger, Charles Kallmyer.

Microscopic precision, multiple spindle, bench type and portable hand-type drilling machines

760 **NATIONAL TOOL COMPANY**
11200 Madison Ave.
Cleveland 2, Ohio

In attendance—H. W. Barkley, H. M. Minor, J. B. Clough, Anton Erhardt, Sr., Anton Erhardt, Jr., John Rhyner, R. Lindstrom, T. L. Shomber, M. Mitchell, M. Dolvig.

Various types special cutting tools, pocket comparator

1140 **NATIONAL TOOL SALVAGE COMPANY**
6511 Epworth Blvd.
Detroit 10, Mich.

In Attendance—Hiram Ash, R. M. Nicolaysen, W. J. Ash, A. B. Hazelwood, H. Bohlin, F. L. Gidley.

Carbide drills, high speed steel and carbide cutting tools

561 **NELCO TOOL COMPANY, INC.**
266 Center St.
Manchester, Conn.

In Attendance—Louis B. Main, Thomas Hollis, Jr., Lee S. Pasino, William A. Coe.

Carbide-tipped cutting tools

25 **NEW HERMES ENGRAVING MACHINE CORPORATION**
13-19 University Place
New York 3, N. Y.

In Attendance — Norbert Schimmel, Werner Dannheisser, Paul Kahn, John Jaffe, Henry Susskind.

Portable and bench-type engraving machines

931 **NICHOLS-MORRIS CORPORATION**
50 Church St.
New York 7, N. Y.

In Attendance—Hart Nichols, Robert E. Morris, M. J. Bloch, S. K. Bigelow, Norman Smith, Keith Douglas.

Milling machines, attachments; vises

12 **NIFE INCORPORATED**
165 Broadway
New York 6, N. Y.

In Attendance—Sven Bergstrom, Joseph Hjelmblad, A. Utterstron, Eric Carlsten.

Universal tool grinder, drill press

632 **PRATT & WHITNEY DIVISION, NILES-BEMENT-POND CO.**
(see Kellerflex Div.)

815 **(see Pratt & Whitney)**

1151 **NILSSON GAGE COMPANY, INC.**
2A Lake St.
Poughkeepsie, N. Y.

In Attendance—John F. Nilsson, Theodore F. Luty, Charles W. Nilsson, John J. Young, Stephen V. Luty.

Various types of gages

335 **C. A. NORGREN COMPANY**
222 Santa Fe Dr.
Denver 9, Colo.

In attendance—Jack M. Evans, Alex Wilcox, Del Faust, C. N. McDavitt.

Pneumatic control devices

409 **NORTON COMPANY**
1 New Bond St.
Worcester 6, Mass.

In Attendance—I. W. Stanton, L. K. Behr, A. O. Bush, R. H. Cannon, F. L. Curtis, K. F. Ebbeson, F. P. Hays, B. D. Henrickson, E. L. Hurst, C. W. Jinnette, R. D. Lane, E. T. Larson, R. M. Lord, M. M. Maynes, R. N. S. Merritt, G. A. Park, D. L. Price, R. A. Reed, G. T. Rideout, C. L. Shaw, L. I. Smith, W. H. Turner, R. G. VanKeuren.

Diamond wheels, ceramic surface plates, boron carbide products, special refractories and other allied products

205 **THE OHIO CRANKSHAFT COMPANY**
(see Tocco Div.)

565 **OAKITE PRODUCTS, INC.**
22 Thames St.
New York 6, N. Y.

In Attendance—J. J. Basch, J. S. Todd, H. P. Jacques, W. G. Boaeuf, C. S. Anderson, B. F. Fay, E. Ward, J. L. DeVries, E. D. Hallett, J. M. Hite, M. Maher.

Specialized cleaning and related materials

221 **THE O. K. TOOL COMPANY**
Division Williams and Hussey Machine Company, Inc.
Wilton, N. H.

In attendance—F. Hussey, T. Williams, W. J. Crabtree, R. W. Greywacz, R. S. Young, G. Ward, C. J. Gluck, W. Wood, H. French.

Turning, planing and shaping tools, milling cutters, toolroom accessories, tool holders

146 **TINIUS OLSEN TESTING MACHINE COMPANY**
Easton Rd.
Willow Grove, Pa.

In attendance—Tinius Olsen, 2nd, E. M. Redstreake, B. L. Lewis, W. C. Stotsenburgh, Erling Jacobsen, S. B. Haney, J. R. Stovall, Jr., R. S. Strimel.

Static and dynamic balancing machine, testing machine

316 **O'NEIL-IRWIN MANUFACTURING COMPANY**
242 Eighth Ave.
Lake City, Minn.

In Attendance—G. H. Danielson, L. C. Wickstrom, P. C. Nelson, V. F. Linder.

Benders, brakes, shears, notchers, punches, rod parters

110 **ORTMAN-MILLER MACHINE COMPANY, INC.**
1222-150th St.
Hammond, Ind.

In Attendance—J. C. Miller, N. H. Ortman, Neill Armstrong, Charles Gilmore, P. W. Rice, D. Y. Rice, Jack Turner, Walter Blackler, Jay Wohlfeld, Cliff Peterson, Cliff Harsted, Al Biener.

Cylinders, boosters, combination feed units, rams

537 **OZALID DIVISION**
General Aniline & Film Corporation
15 Ansco Rd.
Johnson City, N. Y.

In Attendance—Hugh Silbaugh, Lawrence C. Knaphle, James A. Travis, Richard Wilcox, Richard Hanson, Edmund F. Carr, Clark B. Metzger, Fred Garber, John F. Arnold, W. K. Hoyer, E. L. Radoane, R. E. Bryant, Rene B. Faure, R. B. Hilton, L. A. Raino, Henry Wechsler.

Reproduction machines and supplies

749 **PANGBORN CORPORATION**
Hagerstown, Md.

In Attendance—Victor F. Stine, B. H. Marks, H. S. Schellhase, H. J. Symons, W. F. Jones, J. D. Wise, A. Lesley Gardner.

Hydro-finish cabinet for surface cleaning or finishing with specimens of treated work

21 **PEDRICK TOOL & MACHINE COMPANY**
3640 N. Lawrence St.
Philadelphia 40, Pa.

In Attendance—Ralph M. Shaw, Jr., M. R. Shaw, George Metz, Jr., Al Robb.

Bending machines

Product Listings Begin on page 36

942 **PENTON PUBLISHING COMPANY**
Penton Bldg.
1213 W. 3rd St.
Cleveland 13, Ohio

In Attendance—E. L. Shaner, Geo. O. Hays, R. C. Jaenke, F. G. Steinebach, J. W. Zuber, I. H. Such, R. L. Hartford, Colin Carmichael, F. O. Rice, A. N. Gregg, G. R. Ebersole, also editorial and advertising representatives of Steel, Machine Design, The Foundry and New Equipment Digest.

Publications: *Steel, Machine Design, The Foundry, New Equipment Digest;* and technical books

233 **PHYSICISTS RESEARCH COMPANY**
321 South Main St.
Ann Arbor, Mich.

In Attendance—Ernest J. Abbot, Frank W. Kabat, Fred J. Engelke, Bernard W. Poland.

Profilometer equipment for surface roughness measurement

1168 **PINES ENGINEERING COMPANY, INC.**
601 Walnut St.
Aurora, Ill.

In Attendance—B. F. Bower, J. E. Hawking, G. F. Behrend, E. C. Fitzpatrick, I. W. Killian, W. A. Osterland, Glenn Hamlin, R. J. Bratton, William Elliott, Jr., Ransom Soper, F. T. Wright, R. S. Granfield, D. McConaughy, Jr., C. E. Anderson, H. D. Orr, J. B. Riley, J. L. King, P. A. Rickrode, R. T. Rollings, Lloyd J. Hinman, Don Sterner, Nick Lloyd, Jr.

Bending machines and tube and rod finishing machines

532 **PIONEER PUMP & MANUFACTURING COMPANY**
19679 John R St.
Detroit 3, Mich.

In attendance—A. M. Sargent, Clyde Mooney, J. Ralph Griffith, W. H. Frost, J. J. Grum, Wm. B. Van Dike, J. A. Brust, C. Gray.

Impeller and positive displacement type pumps for circulating coolants, lubricants and abrasive liquids

142 **PORTER MACHINE COMPANY**
Cincinnati 9, Ohio

In Attendance—Walter J. Porter, Walter G. Porter, A. H. Turner.

Universal drilling fixture and accessories

142 **PORTER PRECISION PRODUCTS**
Cincinnati 31, Ohio

In Attendance—Walter G. Porter, Roy T. Gullberg, W. C. Tyirin.

Standard head type punches

326 **THE FREDERICK POST COMPANY**
3650 N. Avondale Ave.
Chicago 18, Ill.

In Attendance—Tom Coatney, Paul Phipps, Frank Fetherston, Fred Bishop, Bud Sweeney, Bob Metz, A. D'Annunzio.

Engineering and drafting equipment

1165 **HORACE T. POTTS COMPANY**
D St. & Erie Ave.
Philadelphia 34, Pa.

In Attendance—A. L. Collins, A. W. Ainsworth, D. C. Taylor, Arthur Wells, A. W. Taylor, Norman C. Einwechter, R. A. Kokat, W. Millard, J. W. Reckard, H. O. Whitaker, Horace T. Potts, II, J. C. Angle, J. Henry Kern, H. S. Schofield, G. A. Parker, Jr.

Carpenter tool steel

843 **POWER TOOL DIVISION**
Rockwell Manufacturing Company
600 E. Vienna Ave.
Milwaukee 1, Wis.

In attendance—R. P. Melius, P. Butzin, M. Heinrich, L. Shepard, H. C. Stuckeman, B. Eldridge, W. A. Banister, A. H. Bruckner, R. H. Rockwell, E. T. Hutton, W. A. Hoover.

Abrasive finishing machines, drill head and presses, bench centers, pumps, plates, welders, work heads, vises and homecraft machines

815 **PRATT & WHITNEY DIVISION**
Niles-Bement-Pond Company
Charter Oak Blvd.
West Hartford 1, Conn.

In Attendance—C. M. Pond, A. H. d'Arcambal, J. C. Molinar, J. D. Allan, I. F. Holland, J. B. Wilkie, A. S. Burgoyne, C. A. Page, C. W. Moeller, A. F. Miller, J. R. Cooper, A. M. Dexter, C. Miller, D. Heaton, J. G. Brady, John Sylvester, A. L. Stenglein, F. W. Harrison, H. B. Upham, R. E. Laffler, A. J. Fox, F. A. Armstrong, C. G. Newton, W. W. Stoner, Jr., A. W. Cordonna, A H. Johnson, I. L. Cook.

Gages, measuring equipment, comparators, timing devices, taps, threading dies, milling cutters, reamers, counterbores; special and carbide-tipped multiple point cutting tools

441 **PRECISE PRODUCTS COMPANY**
1328-30 Clark St.
Racine, Wis.

In Attendance—Robert Schumann, Helmut W. Schumann, Jack Kasabian, W. W. Cady, Bill Cady, Jr., Samuel R. Boyer, Harold Martin, Ray Hilbert, Paul F. Hermann, Frank Huey, Karl A. Neise, T. R. Adams, F. C. Houk.

Portable electric grinder-millers, machine tool mounts, flexible shafts, wire strippers, mica undercutters

544 **PRECISION DETROIT COMPANY**
2126 Fairview
Detroit 14, Mich.

In Attendance—Willard F. Thoma, D. J. Smolinski, Gordon Brown, Wilson E. Cole.

Drill assembly presses, index table

1046 **PRECISION GRINDING WHEEL COMPANY, INC.**
8301 Torresdale Ave.
Philadelphia 36, Pa.

In Attendance—George F. Kohn, L. C. Griffin, John W. Basch, W. T. Storey, R. B. Cleaver, F. W. Anderson.

Grinding Wheels

611 **PROCUNIER SAFETY CHUCK COMPANY**
18 S. Clinton St.
Chicago 6, Ill.

In attendance—H. G. Procunier, J. A. McConnell, A. R. Miller, C. P. Morgan, S. Feinberg, G. Mate.

Tapping machine, heads, chucks and collets, friction and tru-grip tap chucks, external threading and stud and screw setting attachments and accessories

657 **PRODUCTION ENGINEERING & MANAGEMENT**
2842 W. Grand Blvd.
Detroit 2, Mich.

In Attendance—Roy T. Bramson, Jerome S. Wilford, Cyril J. Wedlake, Thomas R. Bramson, Michael J. Kelly, Stuart Heminway.

Technical magazine

1042 **PRODUCTION MACHINE COMPANY**
311 Wells St.
Greenfield, Mass.

In Attendance—R. B. Robinson, R. A. Cole, R. W. Schwartz.

Centerless polishing and buffing machine

1065 **THE PRODUCTO MACHINE COMPANY**
990 Housatonic Ave.
Bridgeport 1, Conn.

In Attendance—Elton G. Rogers, Herbert W. Hansen, Donald R. Packard, Philip R. Marsilius, J. Brandon Shaw, Arthur Smedley, Carl A. Gundersen.

Die sets, tool and diemakers' accessories, tapping machine, vises, punch and die, die feeds

308 **PURCHASING**
(see Conover Mast Publications, Inc.)

1119 **PUTNAM TOOL COMPANY**
2981 Charlevoix Ave.
Detroit 7, Mich.

In attendance—Ernest C. Putnam, Melvin L. Weinberg, Bradford B. Mills, Austin F. Vail, Josiah Stickney.

End mills, continuous pilot counterbores, spiral fluted chucking reamers

222 **RACINE TOOL & MACHINE COMPANY**
1760 State St.
Racine, Wis.

In Attendance—J. E. Erskine, H. A. Schultz, G. B. Miller.

Hydraulic pumps, hydraulic valves, hydraulic pressure boosters

720 **RAHN GRANITE SURFACE PLATE COMPANY**
1149 Platt Circle
Dayton 7, Ohio

In Attendance—W. B. Alexander, R. W. Barwood, Chas. S. Fisher, Frank Fries, C. Henderson, P. C. Huber, Arthur M. Johnson, T. A. McMillan, W. Orlick, Gladys I. Peterson, Walter Peterson, R. J. Rahn, Albert S. Roetheli, Earl Elwyn Smith, W. C. Williams.

Complete line of basic precision inspection equipment in black granite.

'04 **THE READY TOOL COMPANY**
550 Iranistan Ave.
Bridgeport 5, Conn.

In Attendance—Carl B. Christensen, James Mitchell, E. M. Benson, N. R. Chruch, Julian Mann, John S. Wright, Axel Olson, Walter J. Greenleaf, W. C. Chapman, K. H. Lockwood, G. B. Westberg.

Centers, dogs, toolholders, vise hold downs, bearings, hammers

947 **REPUBLIC GARAGE COMPANY**
2228 Fenkell Ave.
Detroit 21, Mich.

In Attendance—R. E. Lamb, Sr., R. E. Lamb, Jr., Milton Lapplander, William Laajala.

Wide variety of gages, measuring wires

1020 **RIVETT LATHE & GRINDER, INC.**
18 Riverview Rd.
Brighton 35, Boston, Mass.

In Attendance—Albert B. Hunt, John A. Marsh, Albert E. Kempton, John J. O'Brien, Everett B. Keeler, Donald Newhall.

Hydraulic power units, intensifiers, cylinders, valves; air cylinders and valves

843 **ROCKWELL MANUFACTURING DIVISION**
(see Power Tool Div.)

139 **ROSS OPERATING VALVE COMPANY**
120 E. Golden Gate Ave.
Detroit 3, Mich.

In Attendance—John Sainsbury, R. J. Cameron, Fred Hicks, Jack Rowe, Clifford F. Bassong, William G. Deas, Ralph Earl, J. M. Grinstad, Lou Hacker, Charles Hallett, Robert Hazelring, Elmer Heiser, William E. Hennells, Jim McCormick, S. G. Morris, Russ Niemeier, George M. Pearse, George M. Pearse, Jr., Robert Pearse, Robert Pearson, Walter A. Rankin, George Schlicker, Lou Schlicker, Walter Sleeman, Clarence Tiedman, Foster Weldon, Nick Weslock, Vernon Wiegand, Henry M. Wood, John Williams.

Remote controlled and mechanical operating air valves; also, straight-way, speed control and special purpose valves

517 **ROYAL OAK TOOL & MACHINE COMPANY**
(see D-S Grinder Co.)

204 **H. B. ROUSE & COMPANY**
2214 North Wayne Ave.
Chicago 14, Ill.

In Attendance—Harry W. Knoll, Frank J. Stephan.

Hand miller and fixtures

502 **RUDEL MACHINERY COMPANY, INC.**
100 E. 42nd St.
New York 17, N. Y.

In attendance—T. R. Rudel, W. E. Rudel, W. O. Graham, C. H. Briggs, D. F. Robinson, G. E. Tcimpidis, Robt. Muller, Fred Maurice, Pierre Borel.

Hydroptic milling and jig boring machine and measuring instruments

608 **RUSSELL, HOLBROOK & HENDERSON, INC.**
292 Madison Ave.
New York 17, N. Y.

In Attendance—Roderick M. Ross, Arthur J. Coldwell, Robert T. Lunn, G. R. Osterholm, Richard D. Norby, Fred O. Lombardi, Fred Fendel, Jr., Lewis Russell, H. K. Ferger, W. E. Dorman, H. E. Scott, G. A. Greenwalt, Frank Opferkuch, Jos. Meyer, Melvin Rockefeller.

Automatic screw machine, grinder for carbide and steel tools; tool dresser; drill and tap multiple head

334 **JOSEPH T. RYERSON & SON, INC.**
5200 Grays Ave.
Philadelphia, Pa.

In Attendance—J. W. Queen, W. K. Underhill, J. J. Hauptly, W. S. Ring, W. A. Redpath, F. W. Eichman, R. W. Millow, C. C. Mathews, C. C. Gobdel, W. H. Funk, C. J. Nelson, Jr., J. C. Andes, R. S. Benson, F. L. Eicholtz, L. H. Gillespie, P. B. Heins, G. B. Howell, J. T. Karabas, W. W. Kopf, H. C. Lehne, R. F. Lotacy, R. G. Spang, W. L. Venderhoof, W. J. Winkler, R. J. Young, J. L. Williams, A. B. Burke, W. H. C. Bassett, A. R. Grover, R. A. Laws, L. C. Mercer.

Certified and free-machining alloy steels, ground flat stock

902 **SALES SERVICE MACHINE TOOL COMPANY**
2363 University Ave.
St. Paul 4, Minn.

In Attendance—S. R. Havier, G. F. Booth, L. P. Reiland, P. M. Congdon, A. H. Havir, Geo. Sykora.

Power presses, shapers, hack saws

949 **SCHAUER MANUFACTURING CORPORATION**
2606-68 Reading Rd.
Cincinnati 2, Ohio

In Attendance—A. J. Kohn, S. E. Wright, J. K. Wilson, G. L. Nord, F. G. Kahsar.

Speed lathes

209 **GEORGE SCHERR COMPANY, INC.**
200 Lafayette St.
New York 12, N. Y.

In Attendance—George Scherr, F. Koenig, J. C. Fackiner, E. R. Schwengber, A. A. Crystle.

Jig borer, measuring instruments, projector and microscopes, gear testing and hobbing machines

752 A. SCHRADER'S SON

Division Scovill Manufacturing Co., Inc.

470 Vanderbilt Ave.

Brooklyn 17, N. Y.

In Attendance—Frank H. Churchwell, Frank L. Engstrom, Arthur S. Jorgensen, Shearwood LeCount, Joseph J. Meister, Edwin J. Schan.

Cylinders, valves, pneumatic machine controls, airline fittings, pneumatic equipment

1132 SCHRAMM INC.

West Chester, Penna.

In Attendance—George B. Comfort, Arno O. Witt, Leslie B. Schramm, Joseph E. McGrogan, P. F. Smith.

Electric motor-driven air compressor

752 SCOVILL MANUFACTURING COMPANY, INC.

(see A. Schrader's Son)

643 SCULLY-JONES AND COMPANY

1901 S. Rockwell St.

Chicago 8, Ill.

In Attendance—Wm. L. Voss, Jr., J. R. Brown, B. B. Better, J. Lehde, H. Conn, H. D. Long, J. Kosinski, C. Heira, J. A. Scully, Ed. J. Galvin, Fred Duerre, Dan Flickenger, Harold Gade, Jack Koenig, Tom O'Reilly, H. J. Paffenback, Fred Wright, Hav Wright, D. E. Funk, Jr., Don E. Kaufmann.

Automatic recessing and grooving tools, floating holders, quick lock adapters and nuts, tap holders, adjustable spacing collars, live center, tap chucks and drill drivers

1052 SEIBERT & SONS, INC.

215-217 Taylor St.

E. Peoria 8, Ill.

In Attendance—O. R. Seibert, Glenn Seibert, Warren Seibert, B. V. Seibert, O. M. Merrick, Frank Haggard, Hersch Norris, George Boullain, Ira Mabie, Enie Fink, Ellis Mead, Walter Greenleaf, Ernie Isberg, William Gourlie, Harry Berkshire, Ed. Moore, Nick Maturivitz, Paul O'Neil, H. C. Halbert.

Multiple spindle drilling machine parts

619 SERVICE MACHINE COMPANY

7627-33 South Ashland Ave.

Chicago 20, Ill.

In Attendance—William Heim, Jr., Chris A. Emerson.

Manually-operated presses

953 SEVERANCE TOOL INDUSTRIES, INC.

1514 E. Genesee Ave.

Saginaw, Mich.

In Attendance—Robert Cave, Robert Severance, Dexter Hagaman, Peter DeYoung, Wm. A. Fitzgerald, Bob Pfeifer.

Combined drill and countersinks, rotary files and burrs

1050 SHEFFER COLLET COMPANY

Traverse City, Mich.

In Attendance—Leonard Olsen, Charles J. Mann, Ken Sansom.

Collets, pushers, tubes, special screw machine accessories, feed fingers, cam cutter

836 THE SHEFFIELD CORPORATION

721 Springfield St.

Dayton 1, Ohio

In Attendance—Louis F. Polk, Albert Polk, John Bernard, O. A. Ahlers, Paul Polk, C. H. Reynolds, W. I. Wilt, Louis Mahlmeister, M. E. Cooper, Fred Hummell, Jack Welch, Donald Benbow, Irvin Snyder, James Luthman, Robert Conover, C. W. Hamilton, Jack Barbier, Fred Graham, W. F. Couts, Dave McConnell, Ray Mahlmeister, V. J. Boll, Jerry Baker, W. H. Gourlie, John Merryman, Harry Kiefaber, Frank Blanchette, L. E. Nelson, L. Pittinger, Walter Greenleaf, Walter Katzenmeyer, W. W. Pound, R. C. Woodall, Axel Olson, Todd Whitmore, A. D. Schneider, J. A. Schneider, Jesse Straw, Arthur Homer, George Grassan, Harry Jackson, E. T. Noe, Louis Schultze, C. Dresback.

Wide variety of gages, automatic gaging and segregating equipment, self-opening dieheads, collapsible and solid taps, crush grinding devices and equipment

430 SHELDON MACHINE COMPANY, INC.

4258 N. Knox Ave.

Chicago 41, Ill.

In Attendance—Horace Armstrong, Lyman H. Bellows, George F. Carolan, Leslie E. Happonen, Vernon Larson, W. D. Mills, O. J. Onken, K. J. Pettigrew, Walter B. Rohrer, George McClennen, Sam McClennen, Jack McBride, P. F. Scally, J. McBride.

Lathe, milling machines, shapers

922 SHELL OIL COMPANY

37-06 82nd St.

Jackson Heights, N. Y.

In Attendance—D. E. Hendricks, L. S. Nikora, E. L. Bastian, C. B. Huntoon, T. Dunlap, R. M. Cokinda, M. S. Terwilliger, J. Gilmore, L. Catling, G. Willis, Guy Pence, C. E. Brown.

Complete line of cutting oils, quenching oils, hydraulic oil drawing compounds and rust preventives

1066 **SIMPLEX MACHINE TOOL DIVISION**

(see Stokerunit Corp.)

2 **SIEWEK TOOL COMPANY**

2862 E. Grand Blvd.

Detroit 2, Mich.

In Attendance—C. D. Reason, Daniel R. Reason, Richard Reason, John Rotchford.

Jigs and fixtures, work clamping and tool room accessories, washers, wheels, screws, rest buttons, nuts

516 **SIMONDS ABRASIVE COMPANY**

Tacony & Fraley Sts.

Philadelphia 37, Pa.

In Attendance—C. A. Fee, W. B. Ilko, F .A. Palmer, J. F. Fischer, D. S. Saurman, J. C. Arndt, E. C. Bleam, W. F. Graden, H. C. Tucker, W. G. Wright, R. A. Fair, R. S. Trimble, H. R. Greene, L. J. Musser, K. R. Bartholomew.

Grinding wheels, abrasive grain, fibrex red wheels

516 **SIMONDS SAW AND STEEL COMPANY**

470 Main St.

Fitchburg, Mass.

In Attendance—James Doubleday, Warrin Foster, Eugene Porter.

Circular, band, hack saws; files; rotary, squaring shears; flat ground stock; ground die steel; steel specialties

712 **SIMPSON ELECTRIC COMPANY**

Div. American Gage & Machine Co.

5208 W. Kinzie St.

Chicago 44, Ill.

In Attendance—Herb Bernreuter, William Coon, Jack Whiteside, Leonard Carlson, Mel Beuhring, Ted Frank, Al M. Baehr, John M. Forshay, J. C. Hill, S. K. MacDonald, A. A. Bean, Jim Faries, Jack Mahoney, Nobel C. Shilt.

Electrical meters and testing equipment

Listing of manufacturers' products according to ASTE's numerical index begins on page 86

714 **SIZE CONTROL COMPANY**

Div. American Gage & Machine Co.

2500 W. Washington Blvd.

Chicago, Ill.

In Attendance—W. E. Carroll, E. E. Olds, F. Hlavek, August Tabors, Robert Tabors, L. H. DeWyk, J. A. Batlle, Jay Korest, John Peterson, T. C. Froeberg, Larry Hammond, Richard Guimont, W. B. Wilson, William Cox, F. R. Jodon.

Taper lock, reversible, plain and thread plug gages — steel-carbide-norbide-chrome, thread and gear measuring wires, special gages, cabinet sets, centerless lapper and hold down device

1035 **SOCONY-VACUUM OIL COMPANY, INC.**

26 Broadway

New York 4, N. Y.

In Attendance—P. T. Crowl, W. J. Geggis, Walter Gray, R. C. Gunther, F. S. Hostetler, H. T. Jones, C. S. Simmons, R. A. Townley, F. H. Trenchard, T. H. Webster, A. W. Yoder.

Industrial lubricants, oils, greases, cutting oils, rust preventives, hydraulic fluids

13 **SPERRY PRODUCTS, INC.**

Danbury, Conn.

In Attendance—L. F. A. Mitchell, D. J. LaClair, C. T. Morgan, J. C. Smack, R. H. Frank, G. A. Slader, W. C. Minton, J. F. Kerrigan, H. H. Tatro.

Reflectoscope, reflectogage, hydraulic remote controls, self-sealing couplings, transformers and reactors

923 **SOUTH BEND LATHE WORKS**

425 East Madison St.

South Bend 22, Ind.

In Attendance—G. L. Miller, R. W. Planck, T. M. Pentz, M. E. Trueblood, D. D. Gray, W. O. Robinson, H. L. Swartz, R. G. Keller.

Precision, toolroom, turret lathes; drill presses; bench shaper; attachments and accessories

926 **STANDARD DIE SET MANUFACTURERS, INC.**

1475 Elmwood Ave.

Providence 7, R. I.

In Attendance—Robert F. Moyer, William H. Brunell, P. Franklin Bell, Donald H. Gardner, Haviland Wright, Harold Gade.

Die sets—steel and meehanite

365 **THE STANDARD ELECTRICAL TOOL COMPANY**

2488-96 River Rd.

Cincinnati 4, Ohio

In Attendance—W. A. Ferguson, Ray A. Huhn, W. J. Holtmeier, E. C. Thatcher, A. A. Eakins, James Reid.

Grinders, buffing and polishing machine, dust collecting units, precision grinding spindles

952 **STANDARD GAGE COMPANY, INC.**

70 Parker Ave.

Poughkeepsie, N. Y.

In Attendance—E. Aldeborgh, Noel de Cordova, A. H. Emery, Nils Larson, J. P. Zeleznik, E. L. Sweet, E. M. Boat, A. H. Perkins, F. Schaeffer, Harry N. Carlson, Milton T. Broucek, Geo. E. Hanselman, Harry A. Babb, J. J. Burke, C. H. Jacobs, J. E. Delaney.

Dial type hand gages, dial indicators, comparators, adjustable limit gages, fixed limit gages

128 **STANDARD PRESSED STEEL COMPANY**

Jenkintown, Pa.

In Attendance—J. W. Friel, C. W. Hollingsworth, J. J. Wiest, J. C. Martin, W. I. Kryder, H. Lamborn Smith, James P. Price, H. T. Hallowell, Jr., R. N. Gruber, Crawford Maxson, John T. Turner, Bennett Jones, Robert Sproat, Harold Hafer, Laverne Taylor, James Attwood, Edward Attwood, Edward Gowen, Karl Lang, Arthur J. Knerr, James Harkins, John Hall, A. W. Scott, Harry L. Smith, Earl Liebfried, Frank E. Klinke, Marshel Moorhouse, Edward Moyer, Robert Reese, Peggy H. Staub, K. S. Renninger.

Self-locking nuts, automatic screw machine products, aircraft precision parts, socket screw products and allied items, flat head and self-locking set screws, hollow set square head set, stripper bolts, dry seal pressure plugs, dowel pins, hexagon keys, steel shop and material handling equipment

1157 **STANDARD SHOP EQUIPMENT COMPANY**

82nd & Tinicum Ave.

Philadelphia 42, Pa.

In Attendance—H. Cadwallader, Jr., B. Cadwallader, G. Cadwallader, C. Whitney, E. Irwin.

Set-up appliances for machine tools

745 **THE STAPLES TOOL COMPANY**

2851 Massachusetts Ave.

Cincinnati 25, Ohio

In Attendance—E. M. Staples, Marshall J. Chandler, C. M. Carr, John Long, Robert Maurath, W. E. Berry.

Tungsten carbide tipped reamers, end mills, spot-facers, tool bits, special circular tools, special tool bits

540 **STAR GAUGE COMPANY**

261 Oak Grove Ave.

Springfield 9, Mass.

In Attendance—Gale Forssen, C. A. Bordeau, Benjamin Tiffany, M. H. Baitler.

Grinding fixtures

322 **THE L. S. STARRETT COMPANY**

Crescent St.

Athol, Mass.

In Attendance—W. J. Greene, H. E. Masters, W. W. Haskins, C. O. Newton, K. C. Boyer, C. N. Starrett, D. E. Gilbert, B. J. Hazewinkle, D. Moffat, L. Stone, Ray Starrett, Doug Starrett, Ed. Starrett, G. Hoehn, H. M. Albee, A. M. Starrett, C. J. Nordmark.

Mechanics hand measuring tools and precision instruments, dial indicators, hacksaws and bandsaws, steel tapes, precision ground flat stock

431 **THE STEEL PRODUCTS ENGINEERING COMPANY**

Brehm Die Division

1205 W. Columbia St.

Springfield, Ohio

In Attendance—Charles M. Brehm, Charles M. Brehm, Jr., James W. Powell, Jr., George A. Dalton.

Trimming die in conventional-type press

647 **EDWIN B. STIMPSON COMPANY, INC.**

70 Franklin Ave.

Brooklyn 5, N. Y.

In Attendance—Howard C. Rau, Ralph E. Rau, Herbert Banner, Franklin J. Rau, Frank G. Ascherl, Ralph E. Hector.

Various attaching machines and rivet setting machines, manufactured metal articles including eyelets, rivets, stampings, terminals, arrows and hands, screw machine parts, grommets and washers, ferrules, posts and screws, hole plugs, snap fasteners

1066 **STOKERUNIT CORPORATION**

Simplex Machine Tools Div.

4548 West Mitchell St.

Milwaukee 14, Wis.

In Attendance—L. J. Radermacher, P. O. Wernicke, R. P. Bieszk, J. A. Elwood.

Mechanical and hydraulic feed precision boring machines

106 STONE MACHINERY COMPANY, INC.
P. O. Box 1363
Syracuse, N. Y.

In Attendance—Arthur D. Stone, Ray B. Carroll, Bob Burkhard, Jim Lennie, C. Dal Smith, R. R. Gilbert, George Burnett, Jr., A. A. Peeters, Bill Summerbell, Flave Tyson, Ray Cessna.

Metal cut-off machine

116 D. A. STUART OIL CO., LTD.
2727 S. Troy St.
Chicago 23, Ill.

In Attendance—W. H. Oldacre, F. J. Schmitt, C. N. Cox, J. W. George, H. A. Erickson, M. M. Chatfield, F. W. Smith, J. L. Morosini, F. A. Shute, G. H. Leffel.

Cutting fluids, grinding fluids, drawing compounds

717 SUN OIL COMPANY
1608 Walnut St.
Philadelphia 3, Pa.

In Attendance—A. B. Myler, R. S. Drysdale, A. L. Anderson, J. V. Curley, M. A. Markley, H. B. Price, S. W. Craig, B. M. Dunham, J. N. Kerr, W. G. Beattie, E. J. Pease, C. R. Ahlberg, R. L. Regan, I. E. Owens, R. H. O'Brien, L. T. Unks, M. C. Miller, J. E. Stine, J. Scheidell, R. L. Little, F. C. Goldsborough, E. W. Walter, W. G. Hubbard, C. B. Harding, J. I. C. Taylor, L. C. Alexander, L. H. Fritz, Wm. B. Daub, C. G. Karsch, J. B. Ferguson, Jr., F. R. Markley.

Straight transparent cutting oils, emulsifying cutting oils, quenching oils, rolling oils

907 SUNDSTRAND HYDRAULIC DIVISION
2421 Eleventh St.
Rockford, Ill.

In Attendance—W. A. Staublin, O. E. Mayfield, P. A. Anderson, R. J. Murphy, L. H. Schuette, C. L. Sadler, B. H. Lundgren, H. O. Wahlmark.

Hydraulic tank unit, various hydraulic pumps, motors and valves

907 SUNDSTRAND MAGNETIC PRODUCTS COMPANY
2421 Eleventh St.
Rockford, Ill.

In Attendance—W. W. Westlund, Axel Anderson, John E. Fagerstrom, Eric Anderson, F. H. Robertson, L. Clarke.

Magnetic chucks and holding fixtures for tool room and production machining, magnetic coolant separator

907 SUNDSTRAND PNEUMATIC DIVISION
2421 Eleventh St.
Rockford, Ill.

In Attendance—Robert Nelson, Alvin Nagel, Edgar Landstrom, E. C. Patterson.

Single and two pad pneumatic sanding machines; various sizes of centering and balancing tools

531 SUNNEN PRODUCTS COMPANY
7910 Manchester Ave.
St. Louis 17, Mo.

In Attendance—Joseph Sunnen, W. F. Boldt, August Sunnen, Jr., N. H. Hale, R. S. Nichols, Raymond DeLaRoche, Clifford Fisher, Paul Fischer, R. T. Adolphson, John Mazur, E. R. Gundlach, R. A. Koertge, C. L. Haseman, R. G. MacRae, C. F. Landin, E. B. McWhirter, R. B. Swegles, W. P. Heftye, R. L. Head, L. B. Clough, W. J. MacBride, B. R. McConnell, Sr., Al Del Pico, K. J. Bayer.

Precision honing machines, external hones, portable honing equipment

315 SUPER TOOL COMPANY
21650 Hoover Rd.
Detroit 13, Mich.

In Attendance—G. J. Birgbauer, M. J. Steffes, L. B. Szal, A. J. Schreck, K. R. Fisher, E. A. Isberg, F. M. Wilson, E. C. Barber, R. J. Miller, W. A. S. Connors.

Carbide mills, cutters, saws, reamers, counterbores, core drills, centers, drills, single point tools for turning, facing, threading, boring

558 SUTTON PUBLISHING COMPANY, INC.
(see Metal-Working)

24 SYNTRON COMPANY
Homer City, Pa.

In attendance—A. Murray Metz, E. A. Kreuder, E. G. Woessner, T. S. James, R. B. McMahon, R. H. Scarborough, A. T. Smith, Robert C. White, John O'Hare.

Vibratory small parts feeders

653 TAYLOR DYNAMOMETER AND MACHINE COMPANY
5108 W. Center St.
Milwaukee 10, Wis.

In attendance—Arthur C. Flamme, Charles E. Chavez.

Precision drilling machines, universal static balancing machines

25 **THE TAFT-PEIRCE MANUFACTURING COMPANY**
Woonsocket, R. I.

In Attendance—F. S. Blackall, Jr., W. E. Rogers, P. V. Miller, F. Steele Blackall, III, F. Meyer, Jr., L. F. Hosley, J. N. Tellier, A. R. Shevlin, Thomas McMurtrie, Thomas Millette, Phil Whalen, A. R. Phillips.

Air gages, magnetic chucks, tool room tools, production and inspection tools, gage blocks, A.G.D. and special gages

512 **THE TEXAS COMPANY**
135 E. 42nd St.
New York, N. Y.

In Attendance—N. M. Aycock, A. R. Dunphy, K. H. Thompson, W. C. Lockwood, P. H. Baker, E. D. Gorton, H. E. Ennis, K. E. Blanchard, A. A. Renno, E. Whitesell, H. E. Booz, F. C. Hamilton.

Cutting coolants and lubricants, grease break-down machine

757 **TIDE WATER ASSOCIATED OIL COMPANY**
17 Battery Place
New York 4, N. Y.

In Attendance—K. V. W. Lawrence, W. G. Conrad, W. S. Fenton, J. W. Hannigan, J. O. Dunham, W. B. Joachim, W. H. Marshall, C. B. Caperton.

Complete line of cutting and grinding oils

310 **THE TODD COMPANY, INC.**
1150 University Ave.
Rochester 7, N. Y.

In Attendance—Fred R. Carr, Charles G. Perry, M. Karge, Austin G. Fanning, Raymond H. Barr, Thomas W. Driver.

Karge turnomat

971 **THE TOMKINS-JOHNSON COMPANY**
617 N. Mechanic St.
Jackson, Mich.

In Attendance—W. C. Maier, T. J. Rutledge, Roy Charbonneau, Page Watson, A. Wenckus, G. B. Cranor, A. R. Howland, W. J. Remund, J. R. Elder, J. R. Elder (Mrs.), Willis Miller, James E. White, W. A. Rankin, Richard Rankin, C. Buck, Max Hawley, A. Goris, H. Bush, A. Reichert, John Williams, Jr., A. L. Hacker.

Cutters, arbor press, rivetor, clinchor, air cylinders, hydraulic cylinders

205 **TOCCO DIVISION**
The Ohio Crankshaft Company
3800 Harvard Ave.
Cleveland 1, Ohio

In attendance—W. C. Dunn, Tinkham Veale, W. E. Benninghoff, H. B. Osborn, J. T. Temin, J. T. Vaught, J. F. Cachat, Kenneth Stumpf, H. R. Swartley, William Moore, M. E. Hackstedde.

Electric generator, electrical controls, induction heating units

114 **TOOL & DIE JOURNAL**
Huebner Publications
1975 Lee Rd.
Cleveland 18, Ohio

In Attendance—George J. Huebner, Ray L. Huebner, James K. Gillam, E. Willard Pennington, Carl F. Benner, James G. Doolittle, William O. Dannhausen, R. F. Pickrell, H. Thayer Heaton.

Graphs and other data on metalworking, technical articles, books on plastics molds, practical quality control and materials weight tables

888 **THE TOOL ENGINEER**
10700 Puritan Ave.
Detroit, Mich.

In Attendance—Allan Ray Putnam, Gilbert P. Muir, A. E. Rylander, Doris B. Pratt, Clarence T. Etter, Austin Cragg, James Hartnett, Dorothy Taylor.

Technical journal

1116 **TRABON ENGINEERING CORPORATION**
1814 E. 40th St.
Cleveland 3, Ohio

In Attendance—R. H. Nielson, Felix Wengerter, Gerald A. Hayes, R. C. McCreary, Dale M. Pentz, Henry E. Droneburg, C. O. Anthony, Wilbur Deutsch, E. M. Bartko.

Oil and grease lubricating systems, accessories

1135 **TRUARC RETAINING RINGS DIVISION**
(see Waldes Kohinoor, Inc.)

722 **TUBULAR MICROMETER COMPANY**
St. James, Minn.

In Attendance—R. L. Johnson, H. M. James, Paul Houston, W. J. Sedam, John Shellum.

Precision measuring instruments

536 **TWENTIETH CENTURY MANUFACTURING COMPANY**
3716-20 Montrose Ave.
Chicago 18, Ill.

In attendance—Waldo L. Garberding, Frank Holmes, R. M. Long, Alma Garberding.

Drill, reamer and counterbore sets, tool and die makers, die stops

509 **UNION CARBIDE AND CARBON CORPORATION**
(see Haynes Stellite Co.)

650 **UNION MANUFACTURING COMPANY**
296 Church St.
New Britain, Conn.

In Attendance—W. F. Skillin, G. V. Murphy, G. E. VanWert, C. A. Bedford, G. V. Rogers, W. F. Ebner, W. F. Radune, J. H. O. Page, M. Ellert, R. L. Atkins, C. J. Siegel, J. E. Thompson.

Die sets, hand and air-operated bi-metal chucks, precision scroll chuck, power wrenches

39 **UNITED STATES DEPARTMENT OF COMMERCE**
Philadelphia Regional Office
812 Lafayette Bldg.
437 Chestnut St.
Philadelphia 6, Pa.

In attendance—C. R. Matheson, Patrick P. McCabe, Francis A. Pileggi, Francis J. Doyle, Clifford A. Shedd.

Services, including information on ECA, available to businessmen

748 **UNITED STATES RUBBER COMPANY**
(see L. H. Gilmer Div.)

129 **UNIVERSAL ENGRAVING & COLORPLATE COMPANY, INC.**
(see Engineers Specialties Div.)

1152 **UNIVERSAL VISE & TOOL COMPANY**
Main St.
Parma, Mich.

In Attendance—Nelson B. Beaman, Theodore Klavon, Berry N. Beaman.

Various types of vises, adjustable angle plates, safety work-holders for drill presses

542 **UNIVERTICAL MACHINE COMPANY**
14831 W. 11 Mile Rd.
Box 144, Rte. 2
Royal Oak, Mich.

In Attendance—Charles T. Walker.

Safe "T" hammers, copper electroplating anodes

14 **URBAUER ENGINEERING COMPANY**
Naperville, Ill.

In Attendance—H. C. Urbauer, L. G. Rose, Stanley Sheppard.

Gear master micrometer, jig grinder, grip master vises, hand nibs

764 **V & O PRESS COMPANY**
Hudson, N. Y.

In Attendance—Herman Zorn, Wm. Schug, R. A. Freeman, Geo. R. Kinney, Neil Van Deusen, F. Adams, Walter Lechowski.

Various types of feeds for punch presses

410 **VAN KEUREN COMPANY**
176 Waltham St.
Watertown 72, Mass.

In Attendance—Robt. T. Parsons, Mrs. Robert T. Parsons, W. G. Van Keuren.

Optical flats, monochromatic lights, light wave micrometers, microgages, taper insert and wire-type gages, gage blocks, measuring rolls, cylindrical standards, shop triangles

666 **VANADIUM-ALLOYS STEEL COMPANY**
Latrobe, Pa.

In Attendance—H. A. Hudson, R. R. Elder, Jr., R. A. Cook, J. R. McCarron, Frederick Cooper, H. F. DeLacour, N. M. Russell, Arthur Brookfield, G. A. Roberts, J. Cleveland McKenna, R. Burns George.

Steel for cutting tools and dies with variety of samples

555 **VAPOR BLAST MANUFACTURING COMPANY**
3025 W. Atkinson Ave.
Milwaukee 16, Wis.

In attendance—A. H. Eppler, Verne W. Nichols, S. W. Scott, E. F. Gressing, E. E. Brodhag, A. P. Neumann, K. F. Thomas, L. N. Thomas, W. Arthur Smith, Jr., Carroll M. Aument, Axel G. Vogt, Walter F. Dunn, J. Bishop, Geo. H. Lieser, Walter H. Gray, O. H. Edwards.

Liquid honing machine for small tool users, tools and parts showing results

830 **VERSA-MIL COMPANY**
30 Church St.
New York 7, N. Y.

In Attendance—D. S. McCullough, J. J. Vaughan, George E. Macksoud, Howard Schatz.

Auxiliary for lathes, planers, boring mills and milling machines, portable universal machining unit for heavy equipment

748 **VIBRO-MODULATOR MOUNTS**
1503 Foulkrod St.
Philadelphia 25, Pa.

In attendance—George L. Seifert, Robert Curtsinger, William Weickart, Bror O. Hulgren.

Vibro modulator mounts, industrial cement

239 **VICKERS INCORPORATED**
Division of the Sperry Corporation
1400 Oakman Blvd.
Detroit 32, Mich.

In attendance—R. Esch, M. A. Hayden, W. Brown, A. H. Van Wormer, R. A. Shartle, M. Gray, B. Readman, E. O. Clark, J. C. Carpenter, C. H. Davis, M. A. Fox.

Hydraulic pumps, power units and controls for hydraulic operation of machinery

108 **THE VIKING TOOL COMPANY**
Nichols Rd.
Shelton, Conn.

In attendance—Ole C. Severson, Germain Severson, Charles V. Gluck, R. T. Riffle, Francis M. Feaster, A. P. McLeod.

Various types carbide and high speed steel milling cutters, carbide inserted bit single point tools

427 **VLIER MANUFACTURING COMPANY**
4552 Beverly Blvd.
Los Angeles 4, Calif.

In Attendance—Blaine H. Vlier, Robert A. Simon, Charles O. Price, Ralph Landrum, Carl Loewen, O. E. Vestal, R. H. Poole, R. W. Mason, W. O. Shaver, Charles R. Rhoades, Edgar J. Geist, Alex Morrice, Joe Kennedy, L. R. Helsel, F. H. Fowler, A. R. Williams.

Torque thumb screws, spring plungers and stops, fixture keys

Products Listings Begin on page 86

1135 **WALDES KOHINOOR, INC**
Truarc Retaining Rings Division
47-16 Austel Place
Long Island City 1, N. Y.

In Attendance—H. F. Bower, H. Roberts, J. H. DeBree, H. Heiman, H. Wurzel, G. Schionti, H. McCard, G. Sheppard, R. L. Cragg, E. Conover, S. E. Johnson, F. B. Parker, D. Hornbaker, O. Livingston.

Retaining rings and pliers, grooving tool

908 **WALES-STRIPPIT CORPORATION**
345 Payne Ave.
North Tonawanda, N. Y.

In attendance—George F. Wales, Walter P. Hooper, Jerome F. Ferdinand, Elson Johnson, Clark A. Ralph, Russel J. Bamberger, Homer C. Gray, Jr., Lester J. Haney, Frank V. Fatta, James W. Gaul, Willis Armitage, George F. Kaiser, Thomas E. Wilke, Edward W. Cassidy, Robert B. Gage, Wallace J. Krieger, Hamilton Ernst, A. Tasca, Paul Taylor, William F. Beattie, William Smith, Thomas Jolley.

Sheet metal fabricator, perforating method for television, radio and electronic instrument panels, self-contained piercing and notching equipment

659 **WAHLSTROM TOOL DIVISION**
(see American Machine & Foundry Co.)

105 **WALKER-TURNER DIVISION**
Kearney & Trecker Corp.
South Ave.
Plainfield, N. J.

In Attendance—T. Malek, E. Ryan, W. Antener, P. Yale, R. Stuart.

Production equipment for drilling and tapping, automatic air feed, metal cut-off saws, metal cutting band saws, with power feed

716 **WALSH PRESS & DIE COMPANY**
Div. of American Gage & Machine Co.
4709 W. Kinzie St.
Chicago 44, Ill.

In Attendance—E. J. Weyler, Harry Mekush, Charles Novotny, Stanley Klimak.

Safety devices for punch presses, testing equipment

1142 **WATSON-FLAGG MACHINE COMPANY, INC.**
845 E. 25th St.
Paterson 3, N. J.

In Attendance—J. H. Flagg, Charles Eaton, Richard D. Hart, Carl F. Berbohm, Don Wild, E. H. Hoffman, James Friegel, Bertram Bumsted, Charles C. King, C. L. Shaw.

Precision thread roller, thread roll dies, precision gears, electric gear motors

1041 **THE WEATHERHEAD COMPANY**
300 E. 131st St.
Cleveland 8, Ohio

In Attendance—John Guardiola, William Tomko, A. D. Hodge, A. J. Culbert, B. H. Booms, Neill Armstrong, George Parker, Gus Danz, Robert Focht, Donald Mahoney, William Fleete, J. R. Holiger.

Ermeto and reusable hose end fittings

708 **WEBBER GAGE COMPANY**
12900 Triskett Rd.
Cleveland 11, Ohio

In Attendance—George D. Webber, George B. Webber, Hugh G. Collins.

Precision gage block sets

1013 **WESSON COMPANY**
1220 Woodward Heights Blvd.
Ferndale 20, Mich.

In Attendance—Ray Witham, Jim Smith, George Murphy, Sal Ianniello, Ken Niedhamer, Bob Wagner, Joe Shover, Bill Bader, Frank W. Archer, Ray W. Ruckel.

Tungsten carbide standard and special tips, cutting tools, inserted tooth face milling cutters, solid inserted type mechanically-held lathe tools

1141 **WEST POINT MANUFACTURING COMPANY**
19625 Court
Farmington, Mich.

In Attendance—Arthur Lord, Harold Steintrager, T. E. Wardrope, J. R. Reinertson.

Machine table accessories, jigs and fixtures

Floor plan appears on pages 50-51

1118 **WESTERN TOOL & MANUFACTURING COMPANY, INC.**
1620 E. Pleasant St.
Springfield, Ohio

In Attendance—G. W. Schreck, James D. Harshaw.

Precision and standard mandrels, dressers and cutters, clamps, storage racks

832 **S. B. WHISTLER & SONS, INC.**
752 Military Rd.
Buffalo 17, N. Y.

In Attendance—S. Arthur Whistler, Lawrence V. Whistler, Lawrence V. Whistler, Jr., Edward Merz, William T. Havas, Arthur C. Jackson, Joseph H. Walter, Meyer B. Watson, Arthur R. Allard, J. C. Rumbarger, D. R. Pennington, Harold D. Pearson, Charles A. Jones, George W. Lohr, R. W. Childs, Harold Stephany.

Magnetic and adjustable perforating dies, 90 deg perforating units

109 **WICKMAN MANUFACTURING COMPANY**
15533 Woodrow Wilson Ave.
Detroit 3, Mich.

In Attendance—A. C. Wickman, Hans Mandel, Harold Godwin, Stanley R. Emig.

Bonded diamond wheels, grinders, tapping attachments

731 **WIEDEMANN MACHINE COMPANY**
4272 Wissahickon
Philadelphia 32, Pa.

In attendance—Otto F. Wiedemann, Theo. A. Wiedemann, John Powers, James Chadwick, Ray Baker, Ed Patrick.

Turret punch presses

221 **WILLIAMS & HUSSEY MACHINE COMPANY**

(see The O. K. Tool Co.)

226 **WILSON MECHANICAL INSTRUMENT COMPANY, INC.**
230 Park Ave.
New York 17, N. Y.

In Attendance—V. E. Lysaght, R. B. Coleman, O. H. Shettler, C. H. Thompson, J. L. Kavalaris, P. Kenyon, W. Leopold.

Hardness testers and accessories

WILTON TOOL MANUFACTURING COMPANY

941 Wrightwood Ave.
Chicago 14, Ill.

In Attendance—Hugh W. Vogl, Alex J. Vogl, O. W. Cadle, Charlie Fenner.

Vises and clamps

19

WYNN'S FRICTION PROOFING OIL

2107 W. Tioga St.
Philadelphia 40, Pa.

In Attendance—Howard H. Miller, Harry Wolf, Cecil Troyer.

Industrial oils, inhibitor to oil for reducing friction and preventing metal to metal wear

N. A. WOODWORTH COMPANY

1300 E. Nine Mile Rd.
Detroit 20, Mich.

In Attendance—N. A. Woodworth, R. W. Chadwick, L. E. Moros, Geo. Hohwart, E. Hohwart, E. Mocock, R. Goulder, A. Lundin, Frank Gray, F. H. Robertson, F. Snyder, R. Powell.

Diaphragm chucks, arbors, Cone-lok drill jigs, thread gages, precision parts

1124

ZAGAR TOOL, INC.

24000 Lakeland Blvd.
Cleveland 23, Ohio

In Attendance—Frank Zagar, O. G. Watterman, John Mrsnik, Rosalie Zagar, Alfred Shutt.

Gearless multiple drill heads, collet holding and indexing fixtures

Directory of Exhibited Products

Classified according to ASTE's Numerical Index

27-22290 Abrasive basic products, natural and synthetic

Bay State Abrasive Products Co.; 966
Norton Co.; 409
Simonds Abrasive Co.; 516

34-82000 Abrasive cutting machines, portable

Lipe Rollway Corp.; 115

27-28000 Abrasive wheels (see Grinding wheels)

27-27000 Abrasives, cloth and paper

Carborundum Co.; 1101

34-93000 Adapters for machine tools

Beaver Tool & Engineering Corp.; 433
Benchmaster Mfg. Co.; 1150
Brown & Sharpe Mfg. Co.; 849
Detroit Power Screwdriver Co.; 939
H. E. Dickerman Mfg. Co.; 771
Everede Tool Co.; 311
Falcon Tool Co.; 560
Fidelity Tool Supply; 1143
Chas. L. Jarvis Co.; 807
Lovejoy Tool Co., Inc.; 646
Scully Jones & Co.; 643
Standard Shop Equipment Co.; 1157

31-58110 Air cylinders (see Cylinders, air)

31-16000 Air motors

Bellows Co.; 802

34-94061 Angle plates

Rahn Granite Surface Plate Co.; 720
Universal Vise & Tool Co.; 1152

31-83100 Antifriction bearing-type bushings

Janney Cylinder Co.; 1036

34-47000 Arbor presses (see Presses)

34-93010 Arbors

Beaver Tool & Engineering Corp.; 433
Brown & Sharpe Mfg. Co.; 849
Falcon Tool Co.; 560
Chas. L. Jarvis Co.; 807
Lovejoy Tool Co., Inc.; 646
N. A. Woodworth Co.; 435

27-23000 Abrasive sticks

Carborundum Co.; 1101
Ideal Industries Inc.; 1048

27-26000 Abrasive stones

Sunnen Products Co.; 531

34-93990 Attachments and accessories for machine tools

Bay State Tool & Machine Co.; 35
Cycloid Corp.; 23
H. J. Dion Co.; 6
Errington Mechanical Laboratory Inc.; 554
Ex-Cell-O Corp.; 440
Lovejoy Tool Co., Inc.; 646
Metal Removal Co.; 1160
Modernair Corp.; 957
Ortman Miller Machine Co., Inc.; 110
Porter Machine Co.; 142
Procunier Safety Chuck Co.; 611
Russell Holbrook & Henderson Inc.; 60
South Bend Lathe Works; 923
Sundstrand Pneumatic div.; 907
Syntron Co.; 24
Todd Co., Inc.; 310
Vibro Modulator Mounts; 748
Vlier Manufacturing Co.; 427
Weatherhead Co.; 1041

34-93992 —for grinding machines

Brown & Sharpe Mfg. Co.; 849
D. S. Grinder div., Royal Oak Tool & Machine Co.; 517
Hammond Machinery Builders Inc.; 72
K. O. Lee Co.; 566
Versa Mil Co.; 330

34-93993 —for milling machines

Bemis & Call Co.; 1054
Benchmaster Mfg. Co.; 1150
Bridgeport Machines Inc.; 1031
Index Machine Co.; 1115
Marvin Machine Products Inc.; 1010
Nichols Morris Corp.; 931
Versa Mil Co.; 330

34-93994 —for screw machines

Boyar Schultz Corp.; 133
Carboloy Co., Inc.; 736

34-99000 Attachments for metal-working machines

Allen Manufacturing Co.; 524
Anton Machine Works; 17
Benchmaster Mfg. Co.; 1150
Benzon Machine Co.; 658
Haynes Stellite div., Union Carbide & Carbon; 509
Lipe Rollway Corp.; 115
Marvin Machine Products, Inc.; 1010
Precise Products Co.; 441
Producto Machine Co.; 1065
Power Tool div., Rockwell Mfg. Co.; 843
Russell Holbrook & Henderson Inc.; 608
Sheffer Collet Co.; 1050
Size Control Co., div., American Gage & Machine Co.; 714
Sunnen Products Co.; 531
Versa Mil Co.; 330
Walsh Press & Die Co.; 716

34-99030 Attachments for metal-working machine, air

Bellows Co.; 802

34-99010 Attachments for metal-working machines, hydraulic

Cleveland Industrial Tool Corp.; 1159
Rivett Lathe & Grinder Inc.; 1020

34-63000 Balancing machines

R. B. Annis Co.; 1056
Tinius Olsen Testing Machine Co.; 1146
Taylor Dynamometer & Machine Co.; 653

34-93030 Bars, boring (see Boring bars)

31-80000 Bearings

Amplex Mfg. Co., subsidiary of Chrysler Corp.; 1107
Heim Co.; 559

31-83000 Bearings, alloys

Amplex Mfg. Co., subsidiary of Chrysler Corp.; 1107

31-82000 Bearings, ball

Ex-Cell-O Corp.; 440
Heim Co.; 559
Ready Tool Co.; 304

31-84000 Bearings, plain & mounted

Ready Tool Co.; 304

15-15600 Belts, transmission (see Transmission belts)

34-41000* Bending machines

O'Neil-Irwin Manufacturing Co.; 316
Pedrick Tool & Machine Co.; 21
Pines Engineering Co., Inc.; 1168

75-35000 Blades, machine

Ingersoll Milling Machine Co.; 950

34-68100 Blocks, gage combination sets

Brown & Sharpe Mfg. Co.; 849
DoAll Co.; 121
Pratt & Whitney div., Niles Bement Pond Co.; 815
George Scherr Co., Inc.; 209
Taft-Peirce Manufacturing Co.; 325
Van Keuren Co.; 410
Webber Gage Co.; 708

51-31000 Boilers, steam spray

Livingstone Engineering Co.; 11

25-94000 Bolts

Boyar Schultz Corp.; 133
Morton Machine Works; 437
Producto Machine Co.; 1065
Standard Pressed Steel Co.; 128

34-93140 Bolts, T-slot

F. M. Crayton; 546
Morton Machine Works; 437
West Point Mfg. Co.; 1141

73-13300 Books, engineering

ASTE Handbook; 888
Machinery—Industrial Press; 101

34-93030 Boring bars

Dumore Co.; 959
Everede Tool Co.; 311
Ex-Cell-O Corp.; 440
Gairing Tool Co.; 936
J & S Tool Co., Inc.; 954
Viking Tool Co.; 108

34-93040 Boring heads

C. C. Craley Mfg. Co.; 1149
Everede Tool Co.; 311
Ingersoll Milling Machine Co.; 950
Marvin Machine Products, Inc.; 1010

34-11000 Boring machines

Stokerunit Corp.; 1066

34-11400 Boring machines, jig boring

Hauser Machine Tool Corp.; 838
Moore Special Tool Co., Inc.; 1007
Rudel Machinery Co., Inc.; 502

34-91280 Boring tools

Bokum Tool Co.; 1049
Erickson Tools div., Erickson Steel Co.; 240
Ex-Cell-O Corp.; 440
Falcon Tool Co.; 560
Fidelity Tool Supply; 1143
Giddings & Lewis Machine Tool Co.; 230
Goddard & Goddard Co.; 1108

Boring tools—cont.

Industrial Diamond Assoc. of America, Inc.; 1071
Ingersoll Milling Machine Co.; 950
Chas. L. Jarvis Co.; 807
Madison Manufacturing Co.; 513
Viking Tool Co.; 108

34-91126 **Brazed tools, carbide**

Kennametal Inc.; 914

24-81240 **Brazing alloys, silver**

Handy & Harman; 607

34-91010 **Broaches**

Colonial Broach Co.; 1021
Detroit Broach Co.; 505
Ex-Cell-O Corporation; 440
Illinois Tool Works; 756
National Broach & Machine Co.; 601

34-12000 **Broaching machines**

National Broach & Machine Co.; 601

24-12000 **Bronze, basic shapes & forms**

Ampco Metal Inc.; 1131

79-91260 **Brushes, industrial**

Griffith Raguse & Co., Inc.; 1112

34-19400 **Buffing and polishing machines (see Polishing and buffing machines)**

34-91250 **Burrs rotary (see Rotary burrs)**

34-73130 **Bushings, drill jig**

Accurate Bushing Co.; 142
Ex-Cell-O Corp.; 440
W. F. Meyers Co.; 22

75-80100 **Calipers, production**

Brown & Sharpe Mfg. Co.; 849
Lufkin Rule Co.; 508
L. S. Starrett Co.; 322
Tubular Micrometer Co.; 722

34-91087 **Carbide-tipped reamers**

Staples Tool Co.; 745

34-91129 **Carbide tips, replacement (see Tips, Carbide Replacement)**

34-93190 **Carbides**

Edgcomb Steel Co.; 618

24-12600 **Castings alloy**

Janney Cylinder Co.; 1036

24-20640 **Castings, centrifugal**

Ampco Metal Inc.; 1131
Janney Cylinder Co.; 1036

22-80000 **Castings, steel**

Haynes Stellite div., Union Carbide & Carbon; 509
Janney Cylinder Co.; 1036
Microcast Div., Austenal Laboratories Inc.; 520

34-93050 **Centers**

Ideal Industries Inc.; 1048
Ready Tool Co.; 304
Power Tool Div., Rockwell Mfg. Co.; 843
Scully Jones & Co.; 643
Super Tool Co.; 315
Wesson Co.; 1013

34-91020 **Chasers**

Jones & Lamson Machine Co.; 831

34-93070 **Chuck-holding devices**

Beaver Tool & Engineering Corp.; 433
Scully Jones & Co.; 643
Sundstrand Magnetic Products Co.; 907

34-93060 **Chucks**

American Machine & Foundry Co.; 659
Cushman Chuck Co.; 866
Decastro & Associates; 1058
Erickson Tools div., Erickson Steel Co.; 240
Jacobs Manufacturing Co.; 671
Logansport Machine Co., Inc.; 707
Modernair Corporation; 957
Procunier Safety Chuck Co.; 611
Union Manufacturing Co.; 650
N. A. Woodworth Co.; 435

34-93065 **Chucks, lathe**

Cushman Chuck Co.; 866
E. Horton & Son Co.; 406
Jacobs Manufacturing Co.; 671

34-93062 **Chucks, magnetic**

Brown & Sharpe Mfg. Co.; 849
Hanchett Magna Lock Corp.; 1164
Sundstrand Magnetic Products Co.; 907
Taft-Peirce Manufacturing Co.; 325

34-93063 **Chucks, permanent magnet**

Brown & Sharpe Mfg. Co.; 849

34-93068 **Chucks, tap (Friction)**

Ettco Tool Co., Inc.; 732
Procunier Safety Chuck Co.; 611
Scully Jones & Co.; 643

33-72500 **Cleaning equipment, sand blast**

Pangborn Corporation; 749

31-96490 **Cleaning equipment, steam**

Livingstone Engineering Co.; 11

34-93012 **Collars, spacing**

Scully Jones & Co.; 643

34-93071 **Collets**

Brown & Sharpe Mfg. Co.; 849
Hardinge Brothers Inc.; 701
Jacobs Manufacturing Co.; 671
Procunier Safety Chuck Co.; 611
Sheffer Collet Co.; 1050

35-20000 **Coal mining tools**

Carboloy Co., Inc.; 736

34-91210 **Combined drill & countersinks**

Circular Tool Co., Inc.; 225
Gairing Tool Co.; 936
Grobet File Co. of America Inc.; 1153
Severance Tool Industries Inc.; 953

59-15000 **Combustion analyzers**

Cities Service Oil Co.; 636

34-64100 **Comparators**

Brown & Sharpe Mfg. Co.; 849
Graham Mintel Instrument Co.; 1044
Johnson Gage Co.; 1051
National Tool Co.; 760
Pratt & Whitney div., Niles-Bement Pond Co.; 815
Standard Gage Co., Inc.; 932

34-64110 **Comparators, air**

Taft-Peirce Manufacturing Co.; 325

31-20000 **Compressors, air**

Schramm Inc.; 1132

34-19523 **Contour sawing and filing machines**

Boice Crane Co.; 1139
DoAll Co.; 121

34-60000 **Control systems**

McCaskey Register Co.; 551

32-68000 **Controllers, motor**

Micro Switch; 557

32-60000 **Controls, electrical**

Tocco div., The Ohio Crankshaft Co.; 205

22-99300 **Corrosion resistant alloys**

Haynes Stellite div., Union Carbide & Carbon Corp.; 509

34-91230 **Counterbores**

Arthur & Crafts Co., Inc.; 229
Ex-Cell-O Corporation; 440
Falcon Tool Co.; 560
Gairing Tool Co.; 936
National Tool Co.; 760
Pratt & Whitney div., Niles-Bement Pond Co.; 815
Putnam Tool Co.; 1119
Super Tool Co.; 315
Twentieth Century Manufacturing Co.; 536
Wesson Co.; 1013

57-57000 **Counters**

Ferguson Machine & Tool Co., Inc.; 651

34-91210 **Countersinks and drills** **(see Combined drill and countersinks)**

31-81220 **Couplings**

Foster Manufacturing Co., Inc.; 642
Sperry Products, Inc.

34-19500 **Cut-off, sawing and filing machines**

American Pullmax Co., Inc.; 958
Armstrong Blum Mfg. Co.; 521
Henry P. Boggis & Co.; 401
Campbell Machine div., American Chain & Cable Co.; 226
DoAll Co.; 121
Machine Tool div., Kalamazoo Tank & Silo Co.; 1012
Power Tool div., Rockwell Mfg. Co.; 843
Stone Machinery Co., Inc.; 106
Walker Turner div., Kearney & Trecker Corp.; 105

34-91075 **Cutter, carbide and inserted blade**

Goddard & Goddard Co.; 1108
Viking Tool Co.; 108

34-91070 **Cutter, milling**

Apex Tool & Cutter Co., Inc.; 5
Armstrong Brothers Tool Co.; 1047
Beaver Tool & Engineering Corp.; 433
Brown & Sharpe Mfg. Co.; 849
Ex-Cell-O Corp.; 440
Falcon Tool Co.; 560
Gairing Tool Co.; 936
Goddard & Goddard Co.; 1108
Illinois Tool Works; 756
Ingersoll Milling Machine Co.; 950
Lovejoy Tool Co., Inc.; 646
National Tool Co.; 760
Nelco Tool Co., Inc.; 561
O. K. Tool Co., div., Williams & Hussey Mach. Co.; 221
Pratt & Whitney div., Niles-Bement-Pond Co.; 815
Putnam Tool Co.; 1119
Super Tool Co.; 315
Tomkins Johnson Co.; 971
Viking Tool Co.; 108
Wesson Co.; 1013

34-92000 **Cutting and forming tools for metal forming machines**

Carboloy Co., Inc.; 736
Arthur A. Crafts Co., Inc.; 229

34-92000 Cutting and forming tools for metal forming machines—cont.

Ex-Cell-O Corp.; 440
Fifth Sterling Steel & Carbide Corp.; 1024
Grobet File Co., of America Inc.; 1153
Hardinge Brothers Inc.; 701
Hy-Pro Tool Co.; 763
Illinois Tool Works; 756
J & S Tool Co., Inc.; 954
National Tool Co.; 760
Nelco Tool Co., Inc.; 561
Pratt & Whitney div., Niles-Bement-Pond Co., 815
Simonds Saw & Steel Co.; 516
Waldes Kohinoor Inc.; 1135
Wales Strippit Corp.; 908

18-60000 Cutting oils (see Lubricating and cutting oil and greases)

34-91000 Cutting tools for machine tools

Apex Tool & Cutter Co., Inc.; 5
Bokum Tool Co.; 1049
Danly Machine Specialties Inc.; 850
Ex-Cell-O Corp.; 440
Falcon Tool Co.; 936
Goddard & Goddard Co.; 1108
Haynes Stellite div., Union Carbide & Carbon; 509
Jones & Lamson Machine Co.; 831
National Tool Salvage Co.; 1140
Nelco Tool Co., Inc.; 561
Pratt & Whitney div., Niles-Bement-Pond Co.; 815
Putnam Tool Co.; 1119
Staples Tool Co.; 745
Super Tool Co.; 315
Wesson Co.; 1013

31-58110 Cylinders, air

Bellows Co.; 802
Bendix-Westinghouse Auto Air Brake Co.; 333
Cushman Chuck Co.; 866
Hanna Engineering Works; 772
Hannifin Corp.; 215
Logansport Machine Co., Inc.; 707
Miller Motor Co.; 735
Modernair Corp.; 957
Ortman Miller Machine Co., Inc.; 110
Rivett Lathe & Grinder Inc.; 1020
A. Schraders Son; 752
Tomkins Johnson Co.; 971

34-99010 Cylinders, hydraulic

Hanna Engineering Works; 772
Hannifin Corp.; 215
Logansport Machine Co., Inc.; 707
Miller Motor Co.; 735
Modernair Corp.; 957
Ortman Miller Machine Co., Inc.; 110
Rivett Lathe & Grinder Inc.; 1020
Tomkins Johnson Co.; 971
Vickers Inc.; 239

73-13300 Data, engineering

ASTE Handbook; 888
Machinery—Industrial Press; 101

57-58000 Dial indicators

B. C. Ames Co.; 710
Brown & Sharpe Mfg. Co.; 849
Elgin National Watch Co.; 306
Enco Manufacturing Co.; 303
Federal Products Corp.; 305
Standard Gage Co., Inc.; 932
L. S. Starrett Co.; 322

27-22170 Diamond compound, abrasive

Elgin National Watch Co.; 306
Engis Equipment Co.; 915

36-27100 Diamond coredrills

Industrial Diamond Assoc. of America Inc.; 1071

34-92261 Diamond dies, wire drawing

Industrial Diamond Assoc. of America Inc.; 1071

34-93122 Diamond dressing tools

Carboloy Co., Inc.; 736
Arthur A. Crafts Co., Inc.; 229
Griffith Raguse & Co., Inc.; 1112
Industrial Diamond Assoc. of America Inc.; 1071

27-22160 Diamond dust, lapping

Ace Abrasive Laboratories, Inc.; 1148
Carborundum Co.; 1101
Arthur A. Crafts Co., Inc.; 229
Industrial Diamond Assoc. of America Inc.; 1071

34-93119 Diamond saws

Industrial Diamond Assoc. of America Inc.; 1071

34-93122 Diamond tools

Cleveland Industrial Tool Corp.; 1159

27-28000 Diamond wheels

Arthur A. Crafts Co. Inc.; 229
Industrial Diamond Assoc. of America Inc.; 1071
Norton Co.; 409

9-54000 Diamonds, industrial

Industrial Diamond Assoc. of America Inc.; 1071

34-92140 Dies, blanking

Firth Sterling Steel & Carbide Corp.; 1024

11-72601 **Die casting machine, air**

DCMT Sales Corp.; 412

34-93076 **Die heads**

Errington Mechanical Laboratory, Inc.; 554
Jones & Lamson Machine Co.; 831
The Sheffield Corp.; 836

34-92270 **Die sets**

Danly Machine Specialties, Inc.; 850
Producto Machine Co.; 1065
Standard Die Set Manufacturing, Inc.; 926
Union Manufacturing Co.; 650

34-92232 **Dies, drawing**

Firth Sterling Steel & Carbide Corp.; 1024

34-92130 **Dies, piercing**

Allied Products Corp.; 665
Carboloy Co., Inc.; 736
Heintz Manufacturing Co.; 1002
S. B. Whistler & Sons, Inc.; 832

34-91030 **Dies, threading**

Pratt & Whitney div., Niles-Bement-Pond Co.; 815
Watson Flagg Machine Co., Inc.; 1142

34-92000 **Dies, tool**

A. Milne & Co.; 405
Adamas Carbide Corp.; 406

34-92140 **Dies, trimming**

Steel Products Engineering Co.; 431

34-93993 **Dividing heads**

F. T. Griswold Mfg. Co.; 562
Marvin Machine Prod., Inc.; 1010
Montgomery Machine Tool Accessories; 1053

34-93130 **Dog, lathe (see Lathe dogs)**

34-94901 **Dowel pins**

Allen Manufacturing Co.; 524
Producto Machine Co.; 1065
Standard Pressed Steel Co.; 128

58-83000 **Drafting accessories**

Charles Bruning Co., Inc.; 801
Eugene Dietzgen Co.; 865
Hamilton Manufacturing Co.; 713
Frederick Post Co.; 326

58-81200 **Drafting machines**

Eugene Dietzgen Co.; 865

58-80000 **Drafting room equipment**

Charles Bruning Co., Inc.; 801
Eugent Dietzgen Co.; 865
Frederick Post Co.; 326

34-93064 **Drill chucks**

Ettco Tool Co., Inc.; 732
K. O. Lee Co.; 566

34-73130 **Drill jig bushings (see Bushings, drill jig)**

22-90000 **Drill rods**

Horace T. Potts Co.; 1165

34-99110 **Drill units**

Black Drill Co.; 724
Govro Nelson Co.; 1155

34-93073 **Drilling heads**

Commander Manufacturing Co.; 426
Dumore Co.; 959
Ettco Tool Co., Inc.; 732
Chas. L. Jarvis Co.; 807
Power Tool div., Rockwell Mfg. Co.; 843
Zagar Tool Inc.; 1124

34-13000 **Drilling machines**

Atlas Press Co.; 1008
Boice Crane Co.; 1139
Ettco Tool Co., Inc.; 732
National Jet Co.; 1162
Nife Incorporated; 12
Power Tool div., Rockwell Mfg. Co.; 843
South Bend Lathe Works; 923
Taylor Dynamometer & Machine Co.; 653
Walker Turner div., Kearney & Trecker Corp.; 105

34-13700 **Drilling machine parts**

Seibert & Sons, Inc.; 1052

34-91040 **Drills**

Air Speed Tool Co.; 728
Black Drill Co.; 724
Commander Manufacturing Co.; 426
Arthur A. Crafts Co., Inc.; 229
Firth Sterling Steel & Carbide Corp.; 1024
National Jet Co.; 1162
National Tool Salvage Co.; 1140
Nelco Tool Co.; 561
Super Tool Co.; 315

34-91048 **Drills, core**

Ex-Cell-O Corp.; 440
Gairing Tool Co.; 936
Super Tool Co.; 315
Wesson Co.; 1013

34-83100 **Drills, portable—air**

ARO Equipment Corp.; 741

34-83200 **Drills, portable—electric**

Griffith Raguse & Co., Inc.; 1112
K. O. Lee Co.; 566
National Jet Co.; 1162

31-73200 **Dust collecting equipment**

Hammond Machinery Builders, Inc.; 725

34-72000 **Electroplating anodes**

Univertical Machine Co.; 542

34-72000 **Electroplating and anodizing**

Chrome Electro Forming Co.; 955

33-41700 **Engraving machines**

New Hermes Engraving Machine Corp.; 25

72-10000 **Envelopes, shop**

McCaskey Register Co.; 551

25-60000 **Etching, metal basic products**

Ideal Industries, Inc.; 1048

25-60000 **Fabricated basic metal products**

Heintz Manufacturing Co.; 1002

31-70000 **Fan and blower equipment**

Ideal Industries, Inc.; 1048

31-49900 **Feeding devices**

H. E. Dickerman Mfg. Co.; 771

31-49900 **Feeding devices, automatic**

Decastro & Associates; 1058
F. J. Littell Machine Co.; 6
V. & O. Press Co.; 764

75-34000 **Files and rasps, hand**

Simonds Saw & Steel Co.; 516

34-91180 **Files for machine tools**

Grobet File Co., of America, Inc.; 1153

34-91250 **Files, rotary (see Rotary files and burrs)**

34-19500 **Filing, cut off and sawing machines (see Cut off, filing and sawing machines)**

54-32415 **Filing equipment, visible**

McCaskey Register Co.; 551

31-73210 **Filter, air**

Moore Products Co.; 301
C. A. Norgren Co.; 635

31-98190 **Filters, air line**

M. B. Products; 642

25-72000 **Filters, permanent**

Amplex Mfg. Co., Sub. of Chrysle Corp.; 1107

34-93992 **Fixtures, grinding (see Grinding fixtures)**

34-73100 **Fixtures, jigs and die components (see Jigs, fixtures and die components)**

34-99010 **Flaring machine, hydraulic**

Cox Engineering & Sales Co.; 203

53-92100 **Flashlights, magnetic base**

Enco Manufacturing Co.; 303

31-81200 **Flexible shafts (see Shafts, flexible)**

24-20500 **Forgings, alloy**

Ampco Metal Inc.; 1131

34-92210 **Forming rolls**

Milton Equipment Co.; 619

34-71110 **Furnaces, electric, salt bath**

Ajax Electric Co., Inc.; 434

34-71000 **Furnaces, heat-treating**

Delaware Tool Steel Corp.; 429
Tocco Div., Ohio Crankshaft Co.; 205

34-68100 **Gage blocks, combination sets (see Blocks, gage, combination sets)**

34-66000 **Gages, dial type—inspection and production**

B. C. Ames Co.; 710
Brown & Sharpe Mfg. Co.; 849
Bryant Chucking Grinder Co.; 3
Cadillac Gage Co.; 924
H. E. Dickerman Mfg. Co.; 771
Federal Products Corp.; 305
Johnson Gage Co.; 1051
Lufkin Rule Co.; 508
Nilsson Gage Co., Inc.; 1151
Pratt & Whitney div., Niles-Bement-Pond Co.; 815
Standard Gage Co., Inc.; 932
Tubular Micrometer Co.; 722
N. A. Woodworth Co.; 435

34-65000 **Gages, hand, inspection and production**

Brown & Sharpe Mfg. Co.; 849
Colonial Broach Co.; 1021
Federal Products Corp.; 305
Graham Mintel Instrument Co.; 1044

Johnson Gage Co.; 1051
Moore Products Co.; 301
Nilsson Gage Co., Inc.; 1151
Pratt & Whitney div., Niles-Bement-Pond Co.; 815
Republic Gate Co.; 947
The Sheffield Corp.; 836
Size Control Co. div. American Gage & Machine Co.; 714
Standard Gage Co., Inc.; 932
Taft-Pierce Manufacturing Co.; 325
Van Keuren Co.; 410

34-14570 Gear **burring and chamfering machines**

Modern Industrial Engineering Co.; 30

34-91240 Gear **cutters**

Michigan Tool Co.; 1017
National Broach & Machine Co.; 601
National Tool Co.; 760

34-91270 Gear **hobbing machines**

Hauser Machine Tool Corp.; 838
George Scherr Co., Inc.; 209

34-64200 Gear **measuring and testing machines**

Eastman Kodak Co.; 816
Illinois Tool Works; 756
National Broach & Machine Co.; 601
George Scherr Co., Inc.; 209

31-81700 Gears

Watson Flagg Machine Co., Inc.; 1142

32-11000 Generators, **electric**

Tocco Div., Ohio Crankshaft Co.; 205

27-22000 Grains and powders, **sized**

Griffith Raguse & Co., Inc.; 1112

18-60000 Greases (see **Lubricating and cutting oils** and **greases**)

34-15840 Grinders, **bench**

K. O. Lee Co.; 566

31-32000 Grinders, **hand**

Dumore Co.; 959

34-81200 Grinders, **portable—air**

Aro Equipment Corp.; 741
M. B. Products; 642

34-81000 Grinders, **portable—electric**

Precise Products Co.; 441

34-93992 **Grinding fixtures**

Madison Manufacturing Co.; 513
Star Gauge Co.; 540

34-15000 Grinding machines

Edward Blake Co.; 919
Dumore Co.; 959
Hauser Machine Tool Corp.; 838
Nife Incorporated; 12
Standard Electrical Tool Co.; 965
Urbauer Engineering Co.; 14

34-15000 Grinding machines, carbide

D. S. Grinder div., Royal Oak Tool & Machine Co.; 517
Metal Removal Co.; 1160
Power Tool div., Rockwell Mfg. Co.; 843
Russell Holbrook & Henderson, Inc.; 608
Standard Electrical Tool Co.; 965
Wickman Manufacturing Co.; 109

34-15600 Grinding machines, cutter

Edward Blake Co.; 919
Hammond Machinery Builders, Inc.; 725
Hauser Machine Tool Corp.; 838
Jones & Lamson Machine Co.; 831
Moore Special Tool Co., Inc.; 1007

34-15000 Grinding machines, cylindrical

Crystal Lake Grinders; 740

34-15800 Grinding machines, disc, face and stand

Power Tool Div., Rockwell Mfg. Co.; 843

34-15630 Grinding machines, drill

Edward Blake Co.; 919

34-15800 Grinding machines, flute

Edward Blake Co.; 919

34-15000 Grinding machines, flexible shaft

Kellerflex div., Pratt & Whitney Niles-Bement-Pond Co.; 632

34-15000 Grinding machines, profile

Boyar Schultz Corp.; 133

34-15400 Grinding machines, surface

Airborne Accessories Corp.; 1122
Boyar Schultz Corp.; 133
Crystal Lake Grinders; 740
DoAll Co.; 121
Power Tool div., Rockwell Mfg. Co.; 843

34-15610 Grinding machines, tap

Henry P. Boggis & Co.; 401

34-15000 Grinding machines, tool

DoAll Co.; 121
K. O. Lee Co.; 566
Russell Holbrook & Henderson, Inc.; 608

34-15600 Grinding machines, tool and cutter

Hammond Machinery Builders, Inc.; 725
Hauser Machine Tool Corp.; 838
Jones & Lamson Machine Co.; 831
K. O. Lee Co.; 566
Power Tool div., Rockwell Mfg. Co.; 843
Wickman Manufacturing Co.; 109

27-28000 Grinding wheels

Allison Co.; 206
Bay State Abrasive Products Co.; 966
Carborundum Co.; 1101
Griffith Raguse & Co., Inc.; 1112
Macklin Co.; 943
Metal Removal Co.; 1160
Precision Grinding Wheel Co., Inc.; 1046
Simonds Abrasive Co.; 516
Wickman Manufacturing Co.; 109

34-93120 Grinding wheel dressing equipment

Airborne Accessories Corp.; 1122
J. & S. Tool Co., Inc.; 954
Kellerflex div., Pratt & Whitney Niles-Bement-Pond Co.; 632
Last Word Sales & Engineering Co.; 1161
K. O. Lee Co.; 566
Moore Special Tool Co., Inc.; 1007

27-92250 Guides

Arthur A. Crafts Co., Inc.; 229
Elgin National Watch Co.; 306

75-31140 Hammers, hand

Ready Tool Co.; 304
Univertical Machine Co.; 542

34-71600 Hand milling machines (see Milling machines, hand)

34-93020 Handles and handwheels

Jergens Tool Specialty Co.; 112
Morton Machine Works; 437
West Point Mfg. Co.; 1141

34-61100 Hardness testing machines

Hauser Machine Tool Corp.; 838

34-61110 Hardness testing machine, Brinell

Brinnell Co.; 567

34-61120 Hardness testing machines, Rockwell

Wilson Mechanical Instrument Co., Inc.; 226

34-93040 Heads, boring (see Boring heads)

34-93993 Heads, dividing (see dividing heads)

34-71000 Heat treating equipment

Donovan Co.; 1

34-71001 Heat treating furnaces (see Furnaces, heat treating)

31-50000 Hoists, air

Miller Motor Co.; 735

34-93070 Holding devices (see Chuck holding devices

27-26000 Hones, abrasive

Sunnen Products Co.; 531

34-19300 Honing machines

Sunnen Products Co.; 531
Vapor Blast Mfg. Co.; 555

27-23000 Honing stones

Bay State Abrasive Products Co.; 96
Carborundum Co.; 1101

79-80000 Hose, plastic

Foster Manufacturing Co., Inc.; 642

42-45300 Hydraulic motors (see Motors, hydraulic)

34-42000 Hydraulic presses (see Presses, hydraulic)

31-22400 Hydraulic pumps (see Pumps, hydraulic)

34-93069 Indexing fixtures, chuck

Ettco Tool Co., Inc.; 732
Zagar Tool Inc.; 1124

57-58000 Indicators, dial (see Dial indicators)

31-00000 Industrial machinery and equipment, general purpose

Standard Pressed Steel Co.; 128

34-64000 Inspection, testing and measuring machines

Brown & Sharpe Mfg. Co.; 849
Brush Development Co.; 33
Eastman Kodak Co.; 816
Engr. Specialties div., Universal Engraving & Colorplate Co.; 129
F. T. Griswold Mfg. Co.; 562
Tinius Olsen Testing Machine Co.; 114
Physicists Research Co.; 233
The Sheffield Corporation; 836
Sperry Products, Inc.; 13

34-64420 Inspection, testing and measuring machines surface finishing

Griffith Raguse & Co., Inc.; 1112
Hauser Machine Tool Corp.; 838

42-96100 Instruments, electrical testing

Graham Mintel Instrument Co.; 1044
Martindale Electric Co.; 1147
Simpson Electric Co., Div. American Gage & Machine Co.; 714
Walsh Press & Die Co.; 716

34-11400 **Jig boring machines (see Boring machines, jig boring)**

34-73130 **Jig bushings, drill (see Bushings, drill jig)**

34-73100 **Jigs, fixtures and die components**

Colonial Broach Co.; 1021
Jergens Tool Specialty Co.; 112
Siewek Tool Co.; 2
Vlier Manufacturing Co.; 427
N. A. Woodworth Co.; 435

34-73900 **Jigs and fixtures, air-operated**

Bendix-Westinghouse Auto Air Brake Co.; 333

75-35000 **Knives, machine**

Simonds Saw & Steel Co.; 516

34-93064 **Lathe chucks (see Chucks, lathe)**

34-93130 **Lathe dogs**

Armstrong Brothers Tool Co.; 1047
Ready Tool Co.; 304

34-16000 **Lathes**

Enco Manufacturing Co.; 303
Hardinge Brothers, Inc.; 835
Hauser Machine Tool Corp.; 838
Logan Engineering Co.; 1045
Sheldon Machine Co., Inc.; 430
South Bend Lathe Works; 923

34-16200 **Lathes, bench**

Atlas Press Co.; 1008

34-19430 **Lathes, speed**

Schauer Manufacturing Corp.; 949

32-68500 **Limit switches**

Micro Switch; 557

18-60000 **Lubricating and cutting oils and greases**

Alpha Corp.; 718
F. E. Anderson Oil Co.; 422
Cities Service Oil Co.; 636
Gulf Oil Corp., Gulf Refining Co.; 615
Shell Oil Co.; 922
Socony Vacuum Co., Ltd.; 116
Sun Oil Co.; 717
Texas Co.; 512
Tide Water Associated Oil Co.; 757
Wynn's Friction Proofing Oil; 19

31-97000 **Lubrication equipment**

Air Speed Tool Co.; 728
ARO Equipment Corp.; 741
Cox Engineering & Sales Co.; 203
Fidelity Tool Supply; 1143
Hannifin Corporation; 215
M. B. Products; 642
Trabon Engineering Corp.; 1116

34-97100 **Machine controls, air**

A. Schraders Son; 752

75-35000 **Machine knives and blades**

Simonds Saw & Steel Co.; 516

34-93140 **Machine table accessories**

J & S Tool Co., Inc.; 954
Morton Machine Works; 437
Siewek Tool Co.; 2
Edwin B. Stimpson Co., Inc.; 647
West Point Mfg. Co.; 1141

34-10000 **Machine tools**

National Machinery Exchange; 771
Urbauer Engineering Co.; 14

31-99130 **Magnetic coolant separator**

Sundstrand Magnetic Products Co.; 907

34-93013 **Mandrels, work holding type**

Brown & Sharpe Mfg. Co.; 849
K. O. Lee Co.; 566
Western Tool & Mfg. Co., Inc.; 1118

34-47000 **Manual presses (see Presses, manual)**

79-74100 **Marking devices**

R. B. Annis Co.; 1056
Cadillac Stamp Co.; 753
Montgomery Machine Tool Accessories; 1053

34-49400 **Marking machines**

Cadillac Stamp Co.; 753

36-22000 **Masonry drills**

Carboloy Co., Inc.; 736

34-69001 **Measuring, testing and inspection machine (see Inspection, measuring & testing machine)**

75-30000 **Measuring instruments**

Rudel Machinery Co., Inc.; 502
Industrial Scientific Co.

75-30000 **Measuring tools, magnetic (except mechanics')**

Cadillac Gage Co.; 924

75-80000 **Measuring tools, mechanics'**

Brown & Sharpe Mfg. Co.; 849
Pratt & Whitney div., Niles-Bement-Pond Co.; 815
George Scherr Co., Inc.; 209
L. S. Starrett Co.; 322

34-68200 **Measuring wires**

Size Control Co., div., American Gage & Machine Co.; 714
Van Keuren Co.; 410

57-50000 Mechanical motion, intermittent

Ferguson Machine & Tool Co., Inc.; 651

31-81000 Mechanical power transmission equipment, industrial

Donovan Co.; 1
Link Belt Co.; 721
Standard Pressed Steel Co.; 128
L. H. Gilmer Div., U.S. Rubber Co.; 748

34-43000 Mechanical press (see Presses, mechanical)

34-79010 Metal disintegrators

Clinton Machine Co.; 1057

75-81200 Metal rules

Brown & Sharpe Mfg. Co.; 849
Lufkin Rule Co.; 508
Tubular Micrometer Co.; 722

39-75200 Metal stitcher

Acme Steel Co.; 234

34-80000 Metal-working machines and tools, portable (power driven)

Chas. L. Jarvis Co.; 807

34-91140 Metal-working saws (except solid circular)

Griffith Raguse & Co., Inc.; 1112
Simonds Saw & Steel Co.; 516

75-80500 Micrometers

Brown & Sharpe Mfg. Co.; 849
Lufkin Rule Co.; 508
L. S. Starrett Co.; 322
Tubular Micrometer Co.; 722
Urbauer Engineering Co.; 14
Van Keuren Co.; 410

34-91128 Milling cutter, carbide

Kennametal Inc.; 914

34-91050 Milling cutters (see Cutter, milling)

34-17000 Milling machines

Atlas Press Co.; 1008
Benchmaster Mfg. Co.; 1150
Bridgeport Machines, Inc.; 1031
Hardinge Brothers, Inc.; 835
Hauser Machine Tool Corp.; 838
Index Machine Co.; 1115
Nichols Morris Corp.; 931
Sheldon Machine Co., Inc.; 430

34-17600 Milling machines hand

H. B. Rouse Co.; 204

34-17500 Milling machines, threading

Lassy Tool Co.; 556

31-16000 Motors, air

Bellows Co.; 802

32-13000 Motors, electric

Watson Flagg Machine Co., Inc.; 114

42-45300 Motors, hydraulic

Denison Engineering Co.; 1032
Sundstrand Hydraulic Div.; 907

18-30000 Naptha solvents

F. E. Anderson Oil Co.; 422

34-44800 Nibbling machines

Campbell Machine div., American Chain & Cable Co.; 226
Edward A. Lynch Machinery Co.; 10

34-84000 Nutrunners, portable (power driven) air

ARO Equipment Corp.; 741
H. J. Dion Co.; 6

25-94000 Nuts

Allen Manufacturing Co.; 524
Jergens Tool Specialty Co.; 112
Morton Machine Works; 437
Siewek Tool Co.; 2
Standard Pressed Steel Co.; 128
West Point Mfg. Co.; 1141

56-00000 Optical apparatus and instruments

Bausch & Lomb Optical Co.; 407
Brown & Sharpe Mfg. Co.; 849
Eastman Kodak Co.; 816
Engineers Specialties Div. Universal Engraving & Colorplate Co., Inc.; 129
Engis Equipment Co.; 915
Hauser Machine Tool Corp.; 838
Jones & Lamson Machine Co.; 831
Lufkin Rule Co.; 508
George Scherr Co., Inc.; 209

34-68300 Optical flats

Van Keuren Co.; 410

34-94050 Parallels

Anton Machine Works; 17
Rahn Granite Surface Plate Co.; 70

34-96000 Piercing units, hydraulic

Mueller Engineering Co.; 639

25-94901 Pins, dowel (see Dowel Pins)

25-96400 Pipe fittings

Mueller Engineering Co.; 639
A. Schraders Son; 752

34-89000 Pipe threader, portable

Armstrong Bros. Tool Co.; 1047

57-50000 Mechanical motion, intermittent

Ferguson Machine & Tool Co., Inc.; 651

31-81000 Mechanical power transmission equipment, industrial

Donovan Co.; 1
Link Belt Co.; 721
Standard Pressed Steel Co.; 128
L. H. Gilmer Div., U.S. Rubber Co.; 748

34-43000 Mechanical press (see Presses, mechanical)

34-79010 Metal disintegrators

Clinton Machine Co.; 1057

75-81200 Metal rules

Brown & Sharpe Mfg. Co.; 849
Lufkin Rule Co.; 508
Tubular Micrometer Co.; 722

39-75200 Metal stitcher

Acme Steel Co.; 234

34-80000 Metal-working machines and tools, portable (power driven)

Chas. L. Jarvis Co.; 807

34-91140 Metal-working saws (except solid circular)

Griffith Raguse & Co., Inc.; 1112
Simonds Saw & Steel Co.; 516

75-80500 Micrometers

Brown & Sharpe Mfg. Co.; 849
Lufkin Rule Co.; 508
L. S. Starrett Co.; 322
Tubular Micrometer Co.; 722
Urbauer Engineering Co.; 14
Van Keuren Co.; 410

34-91128 Milling cutter, carbide

Kennametal Inc.; 914

34-91050 Milling cutters (see Cutter, milling)

34-17000 Milling machines

Atlas Press Co.; 1008
Benchmaster Mfg. Co.; 1150
Bridgeport Machines, Inc.; 1031
Hardinge Brothers, Inc.; 835
Hauser Machine Tool Corp.; 838
Index Machine Co.; 1115
Nichols Morris Corp.; 931
Sheldon Machine Co., Inc.; 430

34-17600 Milling machines hand

H. B. Rouse Co.; 204

34-17500 Milling machines, threading

Lassy Tool Co.; 556

31-16000 Motors, air

Bellows Co.; 802

32-13000 Motors, electric

Watson Flagg Machine Co., Inc.; 11

42-45300 Motors, hydraulic

Denison Engineering Co.; 1032
Sundstrand Hydraulic Div.; 907

18-30000 Naptha solvents

F. E. Anderson Oil Co.; 422

34-44800 Nibbling machines

Campbell Machine div., American Chain & Cable Co.; 226
Edward A. Lynch Machinery Co.; 10

34-84000 Nutrunners, portable (power driven) air

ARO Equipment Corp.; 741
H. J. Dion Co.; 6

25-94000 Nuts

Allen Manufacturing Co.; 524
Jergens Tool Specialty Co.; 112
Morton Machine Works; 437
Siewek Tool Co.; 2
Standard Pressed Steel Co.; 128
West Point Mfg. Co.; 1141

56-00000 Optical apparatus and instruments

Bausch & Lomb Optical Co.; 407
Brown & Sharpe Mfg. Co.; 849
Eastman Kodak Co.; 816
Engineers Specialties Div. Universal Engraving & Colorplate Co., Inc.; 129
Engis Equipment Co.; 915
Hauser Machine Tool Corp.; 838
Jones & Lamson Machine Co.; 831
Lufkin Rule Co.; 508
George Scherr Co., Inc.; 209

34-68300 Optical flats

Van Keuren Co.; 410

34-94050 Parallels

Anton Machine Works; 17
Rahn Granite Surface Plate Co.; 702

34-96000 Piercing units, hydraulic

Mueller Engineering Co.; 639

25-94901 Pins, dowel (see Dowel Pins)

25-96400 Pipe fittings

Mueller Engineering Co.; 639
A. Schraders Son; 752

34-89000 Pipe threader, portable

Armstrong Bros. Tool Co.; 1047

34-91120 **Planer tools (see Turning, planter, etc.)**

59-80000 **Plastic hose**

Foster Manufacturing Co., Inc.; 642

34-41400 **Plate and sheet forming rolls**

Edward & Lynch Machinery Co.; 1072

34-12320 **Plate and sheet, rolled**

Ampco Metal, Inc.; 1131

75-31271 **Pliers**

Waldes Kohinoor, Inc.; 1135

57-79000 **Pneumatic control devices**

C. A. Norgren Co.; 635

34-84111 **Polishers, portable—electric**

K. O. Lee Co.; 566

34-19400 **Polishing and buffing machines**

Hauser Machine Tool Corp.; 838
Production Machine Co.; 1042
Standard Electrical Tool Co.; 965
Sundstrand Pneumatic Div.; 907

34-42000 **Presses, hydraulic**

Dake Engine Co.; 1014
Denison Engineering Co.; 1032
Hy-Air Products Co.; 951
Logansport Machine Co., Inc.; 707
Mueller Engineering Co.; 639
Tomkins Johnson Co.; 971
Wiedemann Machine Co.; 731

34-47000 **Presses, manual**

Bellows Co.; 802
Dake Engine Co.; 1014
Logansport Machine Co., Inc.; 707

34-47000 **Presses, manual, punch**

Service Machine Co.; 619

34-43000 **Presses, mechanical**

Precision Detroit Co.; 544

34-43600 **Presses, mechanical, inclinable**

Sales Service Machine Tool Co.; 902

34-43000 **Presses, mechanical, punch**

Benchmaster Mfg. Co.; 1150
Wiedemann Machine Co.; 731

42-54100 **Pressure booster, hydraulic**

Racine Tool & Machine Co.; 222
Rivett Lathe & Grinder, Inc.; 1020

57-75100 **Pressure regulators**

Moore Products Co.; 301

59-12000 **Protective head and face equipment**

Martindale Electric Co.; 1147

31-22000 **Pumps**

Brown & Sharpe Mfg. Co.; 849
Logansport Machine Co., Inc.; 707
Power Tool Div., Rockwell Mfg. Co.; 843

31-22200 **Pumps, centrifugal**

Brown & Sharpe Mfg. Co.; 849

31-22400 **Pumps, hydraulic**

Adel Precision Products Corp.; 1040
Denison Engineering Co.; 1032
Gerotor May Corp.; 655
Modernair Corporation; 957
Racine Tool & Machine Co.; 222
Sundstrand Hydraulic div.; 907
Vickers, Inc.; 239

31-22300 **Pumps, coolant**

Pioneer Pump & Mfg. Co.; 532

34-92000 **Punches (metal forming and cutting)**

Fidelity Tool Supply; 1143
Mueller Engineering Co.; 639
Producto Machine Co.; 1065
Porter Precision Products; 142

34-44000 **Punching and shearing machines**

Edward A. Lynch Machinery Co.; 1072

75-34001 **Rasps and files, hand (see Files & rasps, hand)**

34-91080 **Reamers**

Circular Tool Co., Inc.; 225
Arthur A. Crafts Co., Inc.; 229
Ex-Cell-O Corporation; 440
Falcon Tool Co.; 560
Gammons-Hoaglund Co.; 31
Giddings & Lewis Machine Tool Co.; 230
Goddard & Goddard Co.; 1108
Chas. L. Jarvis Co.; 807
K. O. Lee Co.; 566
Madison Mfg. Co.; 513
National Tool Co.; 760
Pratt & Whitney div., Niles-Bement-Pond Co.; 815
Putnam Tool Co.; 1119
Twentieth Century Mfg. Co.; 536

34-93078 **Recessing tools**

Scully Jones & Co.; 643

76-89120 **Reels, stock**

H. E. Dickerman Mfg. Co.; 771

33-22670 **Reels, yarn**

Brown & Sharpe Mfg. Co.; 849

27-60000 **Refractories**

Norton Co.; 409

57-70000 **Regulators, control (except voltage)**

Hannifin Corp.; 215

57-75100 **Regulators, pressure (see Pressure regulators)**

55-70000 **Reproduction equipment**

Charles Bruning Co., Inc.; 801
Ozalid div., General Aniline & Film Corp.; 537
Frederick Post Co.; 326

55-53000 **Reproduction machines**

Charles Bruning Co., Inc.; 801
Ozalid div., General Aniline & Film Corp.; 537

31-81250 **Retaining rings, external and internal**

Waldes Kohinoor Inc.; 1135

34-74000 **Riveting machines**

Chicago Rivet & Machine Co.; 1123
Mueller Engineering Co.; 639
Tomkins Johnson Co.; 971

25-94000 **Rivets**

Chicago Rivet & Machine Co.; 1123
Edwin B. Stimpson Co., Inc.; 647

22-91200 **Rolls**

Janney Cylinder Co.; 1036

34-91250 **Rotary files and burrs**

Grobet File Co., of America, Inc.; 1153
Chas. L. Jarvis Co.; 807
Kellerflex div., Pratt & Whitney, Niles-Bement-Pond Co.; 632
Martindale Electric Co.; 1147
Metal Remover Co.; 1160
Severance Tool Industries, Inc.; 953
Western Tool & Mfg. Co., Inc.; 1118

34-93990 **Rotary tables**

Benchmaster Manufacturing Co.; 1150
Index Machine Co.; 1115
Marvin Machine Products, Inc.; 1010
Precision Detroit Co.; 544

34-91260 **Router bits, carbide**

Kennametal, Inc., 914

19-40000 **Rust preventives**

F. E. Anderson Oil Co.; 422
Gulf Oil Corp. Gulf Refining Co.; 615
Oakite Products, Inc.; 565
Shell Oil Co.; 922

34-89000 **Sanders, portable—electric**

Griffith Raguse & Co., Inc.; 1112
K. O. Lee Co.; 566

34-91170 **Saw blades, band (metal cutting)**

W. O. Barnes Co., Inc.; 339
Simonds Saw & Steel Co.; 516
L. S. Starrett Co.; 322

34-91150 **Saw blades, circular (metal cutting)**

Martindale Electric Co.; 1147
Simonds Saw & Steel Co.; 516

75-33210 **Saw blades, hack (hand)**

Simonds Saw & Steel Co.; 516

34-91160 **Saw blades, hack (power driven)**

Armstrong Blum Mfg. Co.; 521
W. O. Barnes Co., Inc.; 339
Sales Service Machine Tool Co.; 902
Simonds Saw & Steel Co.; 516
L. S. Starrett Co.; 322

34-19500 **Sawing, cut off and filing machines (see Cut-off, filing & sawing machines)**

34-91140 **Saws, edge hole**

Armstrong Blum Mfg. Co.; 521

75-33000 **Saws and saw blades (except power saw blades)**

Air Speed Tool Co.; 728
E. C. Atkins & Co.; 654
W. F. Meyers Co.; 22

75-33150 **Saws, jewelers**

Circular Tool Co., Inc.; 225

34-91140 **Saws, metal-working (except solid circular) (see Metal-working saws, etc.)**

39-40000 **Scales, machinists (steel)**

Lufkin Rule Co.; 508

34-93994 **Screw machine accessories**

Sheffer Collet Co.; 1050

34-16600 **Screw machines**

Hauser Machine Tool Corp.; 838
Russell Holbrook & Henderson, Inc.; 608

34-16300 **Screw machines, hand**

Hardinge Brothers, Inc.; 701

34-84000 **Screwdrivers, portable—power driven**

Detroit Power Screwdriver Co.; 939

25-94000 **Screws**

Allen Manufacturing Co.; 524
Jergens Tool Specialty Co.; 112
Morton Machine Works; 1065
Producto Machine Co.; 1065
Siewek Tool Co.; 2
Standard Pressed Steel Co.; 128
Vlier Manufacturing Co.; 427
West Point Mfg. Co.; 1141

25-94310 **Screws, cap and set**

Allen Manufacturing Co.; 524
Allied Products Corp.; 665

31-81200 **Shafts, flexible**

Precise Products Co.; 441

34-91120 **Shaper tools (see Turning, planer and shaper tools)**

34-19100 **Shapers (except gear shapers)**

Atlas Press Co.; 1008
Logan Engineering Co.; 1045
Sales Service Machine Tool Co.; 902
Sheldon Machine Co., Inc.; 430
South Bend Lathe Works; 923

34-44000 **Shearing and punching machines**

Milton Equipment Co.; 619
O'Neil-Irwin Mfg. Co.; 316
Wales Strippit Corp.; 908

34-41300 **Sheet press and apron brakes**

Edward A. Lynch Machinery Co.; 1072

24-81240 **Silver brazing alloys, (see Brazing alloys, silver)**

34-91130 **Solid circular saws and slitting saws**

Circular Tool Co., Inc.; 225
Martindale Electric Co.; 1147

18-30000 **Solvents**

F. E. Anderson Oil Co.; 422
Cities Service Coil Co.; 636

34-93012 **Spacing collars (see Collars, spacing)**

34-91231 **Spotfacers**

Staples Tool Co.; 745

25-78000 **Springs, wire**

Elgin National Watch Co.; 306
Producto Machine Co.; 1065

22-99300 **Stainless steel**

Amplex Mfg. Co., Sub. of Chrysler Corp.; 1107

25-60000 **Stamping, metal basic products**

Anderson & Sons, Inc.; 329
Detroit Stamping Co., Finished Products div.; 321
Heintz Manufacturing Co.; 1002
Edwin B. Stimpson Co., Inc.; 647

22-99200 **Steel, alloy**

Haynes Stellite div., Union Carbide & Carbon; 509

22-20000 **Steel, semi-finished forms and shapes**

Allied Products Corp.; 665
Allegheny Ludlum Steel Corp.; 618
Latrobe Electric Steel Co.; 808
A. Milne & Co.; 405
Horace T. Potts Co.; 1165

22-20000 **Steel, tool and die**

Edgcomb Steel Co.; 618
Firth Sterling Steel & Carbide Corp.; 1024
Latrobe Electric Steel Co.; 808
A. Milne & Co.; 405
Horace T. Potts Co.; 1165
Joseph T. Ryerson & Son, Inc.; 334
Vanadium Alloys Steel Co.; 666

27-23000 **Stones, honing (see Honing stones)**

75-79900 **Storage**

Western Tool & Mfg. Co., Inc.; 1118

75-81400 **Straight edges**

Brown & Sharpe Mfg. Co.; 849
The Herman Stone Co.; 15
Rahn Granite Surface Plate Co.; 720

34-64420 **Surface finish measuring machines (see Inspection, testing and measuring machines, surface finish)**

34-94064 **Surface plates**

Acme Tool Co.; 766
Brown & Sharpe Mfg. Co.; 849
The Herman Stone Co.; 15
Norton Co.; 409
Rahn Granite Surface Plate Co.; 720
Power Tool div., Rockwell Mfg. Co.; 843
Taft-Pierce Manufacturing Co.; 325

34-93210 **Tap holders**

Scully Jones & Co.; 643

75-80700 **Tapes, metal precision**

Lufkin Rule Co.; 508
L. S. Starrett Co.; 322

34-93075 **Tapping attachments**

American Machine & Foundry Co.; 659
Commander Manufacturing Co.; 426

34-93075 **Tapping attachments—cont.**

Errington Mechanical Laboratory, Inc.; 554
Ettco Tool Co., Inc.; 732
Chas. L. Jarvis Co.; 807
Wickman Manufacturing Co.; 109

34-93075 **Tapping heads**

Ettco Tool Co., Inc.; 732
Chas. L. Jarvis Co.; 807
Kaufman Mfg. Co.; 1120
Procunier Safety Chuck Co.; 611

34-19700 **Tapping machines**

Boice Crane Co.; 1139
Ettco Tool Co., Inc.; 732
Kaufman Mfg. Co.; 1120
Lassy Tool Co.; 556
Procunier Safety Chuck Co.; 611
Producto Machine Co.; 1065

34-99120 **Tapping units**

Govro Nelson Co.; 1155

34-91110 **Taps**

Arthur A. Crafts Co., Inc.; 229
Hy-Pro Tool Co.; 763
Chas. L. Jarvis Co.; 807
The Sheffield Corp.; 836

34-64001 **Testing machines (see Inspection, testing & measuring machines)**

34-61100 **Testing machines, hardness (see Hardness testing machines)**

34-62000 **Testing machines, structure and composition**

Magnaflux Corp.; 563

34-17500 **Threading milling machines (see Milling machines, thread)**

34-19700 **Threading and tapping machines**

Watson Flagg Machine Co., Inc.; 1142

34-91129 **Tips, carbide replacement**

Adamas Carbide Corp.; 406
Allegheny Ludlumm Steel Corp.; 618
Armstrong Bros. Tool Co.; 1047
Carboloy Co., Inc.; 736
Ex-Cell-O Corp.; 440
Firth Sterling Steel & Carbide Corp.; 1024
Ingersoll Milling Machine Co.; 950
Kennametal, Inc.; 914
O. K. Tool Co., div., Williams & Hussey Machine Co.; 221
Pratt & Whitney div., Niles-Bement-Pond Co.; 815
Staples Tool Co.; 745
Viking Tool Co.; 108
Wesson Co.; 1013

34-91120 **Tool bits**

Everede Tool Co.; 311
Staples Tool Co.; 745
Viking Tool Co.; 108

75-79300 **Tools and utility boxes**

Frick Gallagher Mfg. Co.; 631
Standard Pressed Steel Co.; 128

34-93210 **Tool holders**

Acme Tool Co.; 766
Aplex Tool & Cutter Co., Inc.; 5
Edward Blake Co.; 919
Bokum Tool Co.; 1049
Cycloid Corp.; 23
Erickson Tools div., Erickson Steel Co.; 240
Errington Mechanical Laboratory, Inc.; 554
Everede Tool Co.; 311
Gairing Tool Co.; 936
O. K. Tool Co., div., Williams & Hussey Machine Co.; 221
Ready Tool Co.; 304
Scully Jones & Co.; 643

34-94000 **Toolroom accessories**

Acme Tool Co.; 766
Allied Products Corp.; 665
R. B. Annis Co.; 1056
Armstrong Brothers Tool Co.; 1047
Bay State Tool & Machine Co.; 35
Boyar Schultz Corp.; 133
Brown & Sharpe Mfg. Co.; 849
Arthur A. Crafts Co., Inc.; 229
Detroit Stamping Co.; 321
Fidelity Tool Supply; 1143
Hanchett Magna Lock Corp.; 1164
Heim Co.; 559
Jergens Tool Specialty Co.; 112
Lassy Tool Co.; 556
Montgomery Machine Tool Accessories; 1053
Moore Special Tool Co., Inc.; 1007
O. K. Tool Co., div. Williams & Hussey Machine Co.; 221
The Sheffield Corp.; 836
Siewek Tool Co.; 2
Simonds Saw & Steel Co.; 516
L. S. Starrett Co.; 322
Taft-Peirce Manufacturing Co.; 325
Twentieth Century Manufacturing Co.; 536
West Point Mfg. Co.; 1141
Western Tool & Mfg. Co., Inc., 1118
Wilton Tool Mfg. Co.; 550

36-20000 **Tools, coal mining (see Coal mining tools)**

34-91990 **Tools, cutting for machine tools (see Cutting tools for machine tools)**

75-80000 **Tools, mechanics' measuring**

L. S. Starrett Co.; 322

72-94100 Towels, industrial

Institute of Industrial Launderers, Inc.; 552

73-30300 Trade papers

American Machinist, McGraw-Hill Publishing Co.; 416
Chilton Co., Automotive Industries; 408
Conover Mast Publications, Inc.; 308
Modern Machine Shop, Gardner Publications; 1111
Hitchcock Publishing Co.; 548
Iron Age; 210
Machinery, Industrial Press Publishers; 101
Metal-Working, Sutton Publishing Co., Inc.; 558
Penton Publishing Co.; 942
Production Engineering & Management; 657
Bramson Publishing Co.; 657
Tool & Die Journal, Huebner Publications; 114
The Tool Engineer; 888
U. S. Dept. of Commerce; 39

15-15600 Transmission belts

L. H. Gilmer Div., U. S. Rubber; 748

31-81000 Transmission equipment (*see* **Mechanical power transmission equipment, industrial**)

74-59200 Tube fittings

Flodar Corp.; 203

34-91120 Turning, planer and shaper tools

Gidding & Lewis Machine Tool Co.; 230
Illinois Tool Works; 756
O. K. Tool Co., div., Williams & Hussey Machine Co.; 221

34-99110 Units, drill

Govro Nelson Co.; 1155

34-99120 Units, tapping

Govro Nelson Co.; 1155

31-58110 Valves, air

Bellows Co.; 802
Galland-Henning Mfg. Co., Nopak Div.; 844
F. J. Littell Machine Co.; 622
Modernair Corp.; 957
Ross Operating Valve Co.; 139

57-79000 Valves, control (except voltage)—air

Adel Precision Products Corp.; 1040
Bendix-Westinghouse Auto Air Brake Co.; 333
Hanna Engineering Works; 772
Hannifin Corp.; 215
Logansport Machine Co., Inc.; 707
M. B. Products; 642
Modernair Corp.; 957
Mueller Engineering Co.; 639
Rivett Lathe & Grinder, Inc.; 1020
Ross Operating Valve Co.; 139
A. Schraders Son; 752

57-79000 Valves, control (except voltage)—hydraulic

Denison Engineering Co.; 1032
Hanna Engineering Works; 772
Logansport Machine Co., Inc.; 707
Modernair Corp.; 957
Mueller Engineering Co.; 639
Racine Tool & Machine Co.; 222
Rivett Lathe & Grinder, Inc.; 1020

42-94200 Valves, hydraulic

Adel Precision Products Corp.; 1040
Galland-Henning Mfg. Co., Nopak Div.; 844
Modernair Corp.; 957
Sundstrand Hydraulic div.; 907
Vickers, Inc.; 239

57-73000 Valves, control—solenoid

Ross Operating Valve Co.; 139

34-94140 V-Blocks

Acme Tool Co.; 766
Brown & Sharpe Mfg. Co.; 849
Lassy Tool Co.; 556
Taft-Peirce Mfg. Co.; 325

34-93150 Vises, machine table

Bay State Tool & Machine Co.; 35
Bellows Co.; 802
Brown & Sharpe Mfg. Co.; 849
Float Lock Corp.; 4
Hanchett Megna Lock Corp.; 1164
Nichols Morris Corp.; 931
Producto Machine Co.; 1065
Ready Tool Co.; 304
Power Tool div., Rockwell Mfg. Co.; 843
Universal Vise & Tool Co.; 1152
Urbauer Engineering Co.; 14
Wilton Tool Mfg. Co.; 550

75-31450 Vises, upright

Nichols Morris Corp.; 931
Producto Machine Co.; 1065

25-94000 Washers

Morton Machine Works; 437
Siewek Tool Co.; 2
Edwin B. Stimpson Co., Inc.; 647
West Point Mfg. Co.; 1141

34-93190 Wear strips

Adamas Carbide Corp.; 406
Ampco Metal, Inc.; 1131
Amplex Mfg. Co., subsidiary of Chrysler Corp.; 1107
Haynes Stellite div., Union Carbide & Carbon; 509
Kennametal, Inc.; 914

34-51180 Welding electrodes

Ampco Metal, Inc.; 1131
Graham Mfg. Corp.; 672

34-50000 Welding equipment

Graham Mfg. Corp.; 672
K. O. Lee Co.; 566
Power Tool div., Rockwell Mfg. Co.; 843

27-28100 Wheels, diamond (see Diamond wheels)

27-28000 Wheels, grinding (see Grinding wheels)

34-46900 Wire strippers

Precise Products Co.; 441

34-68200 Wire, measuring (see Measuring wires)

33-60000 Woodworking machines

American Machine & Foundry Co.; 65[illegible]

67-32260 Work clothes, industrial

Institute of Industrial Launderers, Inc.; 552

75-31470 Wrenches, master

Armstrong Bros., Tool Co.; 1047

34-84140 Wrenches, portable—air

Union Manufacturing Co.; 650

Part Three

Convention Papers—

Carbide Die Developments

By George Eglinton
VICE PRESIDENT
LINCOLN PARK INDUSTRIES INC.

PROBABLY THE MOST important consideration in the mind of the prospective user of a carbide die is whether the stamping job under consideration justifies the use of carbide. It is obvious that if one or more presses are engaged full time in the production of one stamping then consideration should be given to the use of carbide. Most of the dies built so far have been used under these conditions.

The borderline between when to use a carbide die and when not to is hard to establish, especially when only one steel die is required to maintain production. It might seem in this case that carbide would not justify consideration at all, since it is sure to require a heavier initial outlay. However, it might be that press time could be shortened to the point where the press could take on other work; the maintenance time involved in servicing the steel die might be considerable; and the quality of the stamping be so improved by making it in a carbide die that subsequent inspection or assembly problems are reduced or eliminated. Any one, or a combination of these conditions could justify a carbide die.

Probably the earliest approach to operating carbide in a cutting application in a punch press was the substitution of cutting elements of carbide to replace steel elements formerly used. Some of these first applications must have been satisfactory, or at least have been encouraging, or the project would have stopped there. It is our experience, however, that few steel dies are built to the accuracy necessary to provide proper support to the carbide, and to deliver good performance, in this type of installation.

The second approach used has been to make all the functioning elements of carbide but to follow the same design and construction quality previously used in the steel dies. This practice has worked out to the satisfaction of several users but it too has its drawbacks. We would bring the same approach to the manufacture of a carbide die that has been found necessary in the development of other carbide tools, and that is to design the job for carbide and to establish quality standards throughout the die that will properly support the carbide.

In this connection it should be remembered that the building of a carbide die is prompted by a desire or need for higher quality in the stamping, or longer performance of the tool, or both. In some way, it must better the job, or lower its cost. The inherent wear resistance of the carbide itself will deliver these improvements as far as the cutting edges are concerned. But the fit of the sections to each other and to the die set must be of far higher quality than has been customary in steel dies, if these cutting edges are to deliver all the performance of which they are capable.

Carbide dies require a maximum of strength and rigidity and they are forced to operate today in press equipment that leaves much to be desired. We can't expect new presses designed for carbide overnight but we can take good advantage of existing press equipment by designing and building the best possible die. We have found that it pays off to establish the fits and joints throughout the die shoes, stripper plates, punch holders and in the die sections themselves to the accuracies usually required on gages. Dies built in this fashion have resisted the malfunctions of the punch press, feeding devices and takeaway devices which seem to fail more often with carbide dies than they formerly did with steel dies.

Actually these mechanisms which surround the die do fail more often than they formerly did but it should be remembered that they are subjected to a substantially heavier demand than they formerly were. A carbide die is expected to stay in the press anywhere from ten to fifty times as long as a steel die would stay there. Since the steel die had to be removed whenever the cutting edges dulled and the burr became excessive, the chances are that these surrounding mechanisms got a little attention each time a die was removed or installed. The carbide die on the other hand is still in the press, still delivering high quality burr-free blanks, so no one thinks to give attention to these other mechanisms. Malfunctions of many kinds occur in punch presses. Scrap has jammed at the take-out end of the die while the in-fed still functions. This telescopes a strip of stock into the die, which piles up an excessive load under one end, and if the operator isn't alert and stops the press immediately, the die is subjected to terrific abuse. Feeders have become mis-timed causing the strip to inch along in the die, with the result that

the punches are nibbling partial blanks. On the slide-feed single-blank type of operation usually operated in inclined presses, we have seen part of the feeding mechanism fall partway into the die and stall the press. Knockouts have failed in compound dies and failed to eject the blanks while the feeding device continues to feed blanks into the die. In one instance in a single feed operation the motor failed on a conveyor belt behind the press which was carrying away finished blanks. The take-away chute filled with blanks to the point where blanks backed up and lay all over the die. The operator failed to stop the press before it stalled. All of these things have happened to carbide dies and the dies have survived with little or no damage.

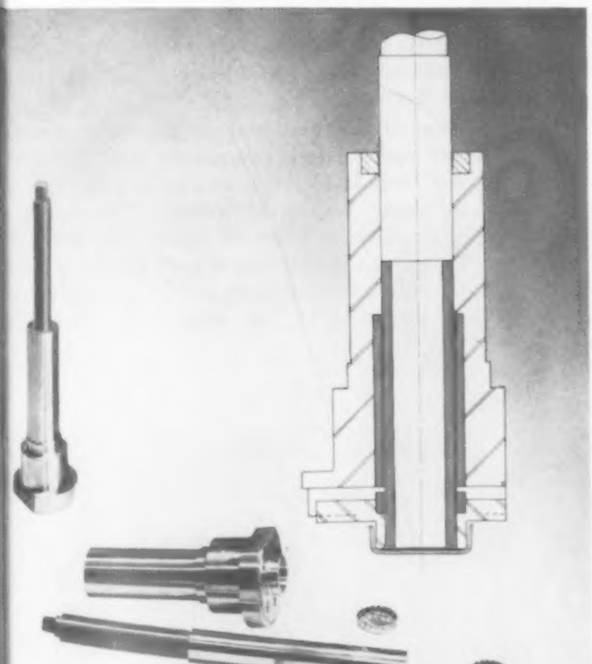
Now the dies didn't survive these malfunctions simply because they were carbide, because obviously carbide is not stronger than the tool steel it is replacing. They survived because the maximum of strength was built into them and the dies were truly stronger than the press itself. It may add more to the cost of a carbide die to provide these precautions but in many instances it can be done and it is worth the investment to do it. I don't mean to add extra frills to a die, unless we can see a contribution that it will make to the die's operation. I do think that it is advisable to put everything into the die that can in any way strengthen it.

The most difficult designing problem we have in this work is in sectioning the die and holding the punches. We don't have the latitude in either case that we have in steel dies. We can't shape up a piece of carbide and leave a uniform 0.020 in. of grinding stock as we can with a piece of tool steel.

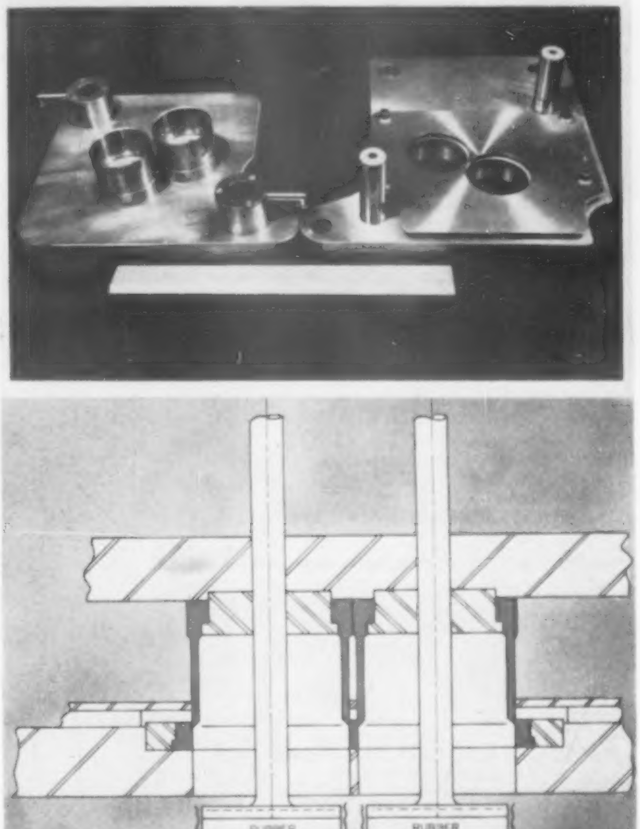
Neither can we drill a screw or dowel hole wherever we desire. Two or more piercing holes in one section are hard to produce, especially if the center distances must be held close, or if the holes are small. Punches must usually be made without flanges and must be held in carefully fitted subholders. Some early attempts were made to braze punches to their holders, but most of these failed and we are committed to mechanically-held punches.

Replacement of Carbide Sections

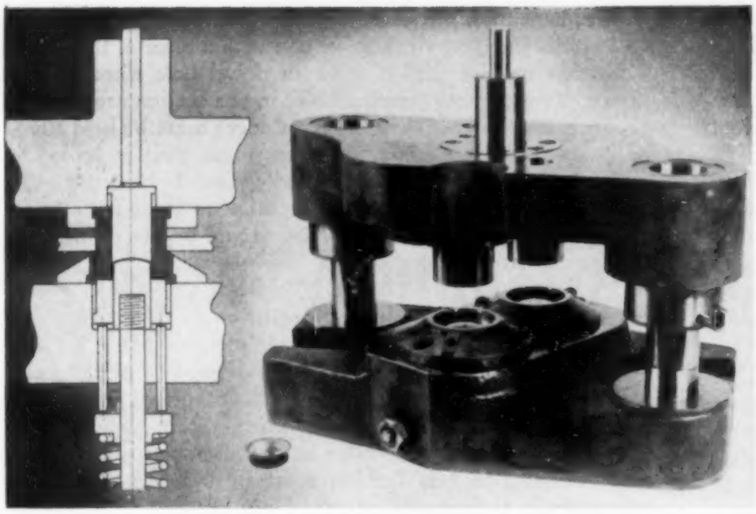
Many high-activity steel dies are designed to permit easy replacement of die sections or punches. Standard dimensions have been established, and spare parts are made when the die is made, or are made later to the original specifications. Jobs designed in this fashion must incorporate reasonable tolerances in their specifications. Unfortunately, the reasonable tolerances established on the steel dies are not reasonable for carbide. Let's examine this a little further. The job is recognized as one that will wear out punches or die sections rapidly, so we design to simplify replacement. The very act of simplifying replacement makes the parts vulnerable to even more rapid wear, since we must have some tolerances to accomplish interchangeability. Many users have had carbide failers in this type of application, and as a result have condemned carbide for the job.



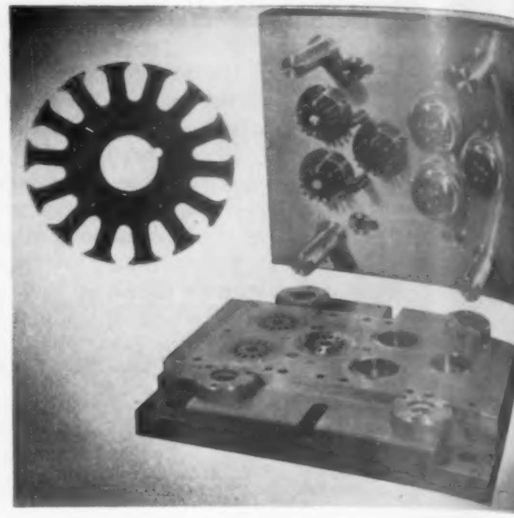
Spot punch and die assemblies of carbide such as this are in use by most of the beverage bottle crown makers in the United States. Material is 0.002 aluminum foil strip. Punch blanks the foil spot, carries it through the die, and fixes it to the cork already in place in the crown. Crowns are fed automatically into position at speeds above 300 per minute. Clearance is not over 0.00015 in. per side and 0.002 in. thick material.



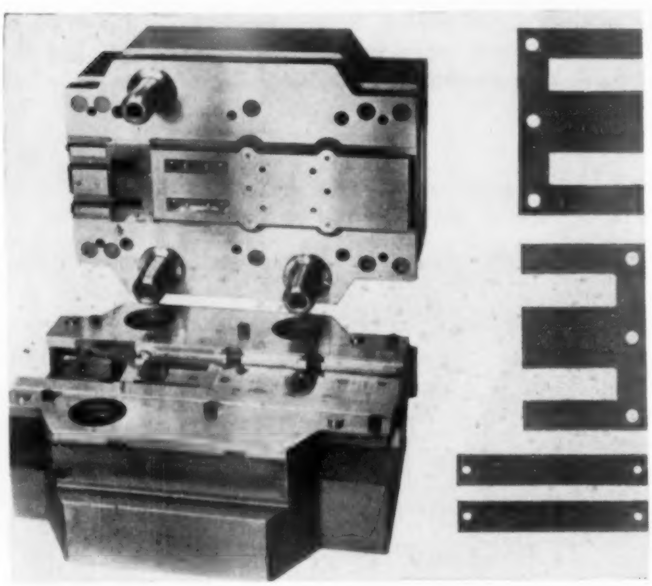
These carbide dies blank and install the paper liner in glass bottle and jar screw caps. The punch section is less than 1/16 in., in order that the assembling plunger may have maximum surface area. They operate in a double action mechanism which permits the blanking punch to dwell while plunger carried blank through and into the cap, which is automatically fed into position.



The die above blanks and draws screw caps. The edge is folded, threads rolled and liner installed later. This particular die has been in two-shift operation for fourteen months without having been removed from the press, whereas steel dies on the same job require sharpening on an average of once a week. Material punched is 0.010 to 0.012 in. thick tin plate.



Automobile generator armature laminations are punched on this die. Six of these dies have accounted for savings of $45,000 in one year in die cost alone. In addition they have substantially increased production per man hour.

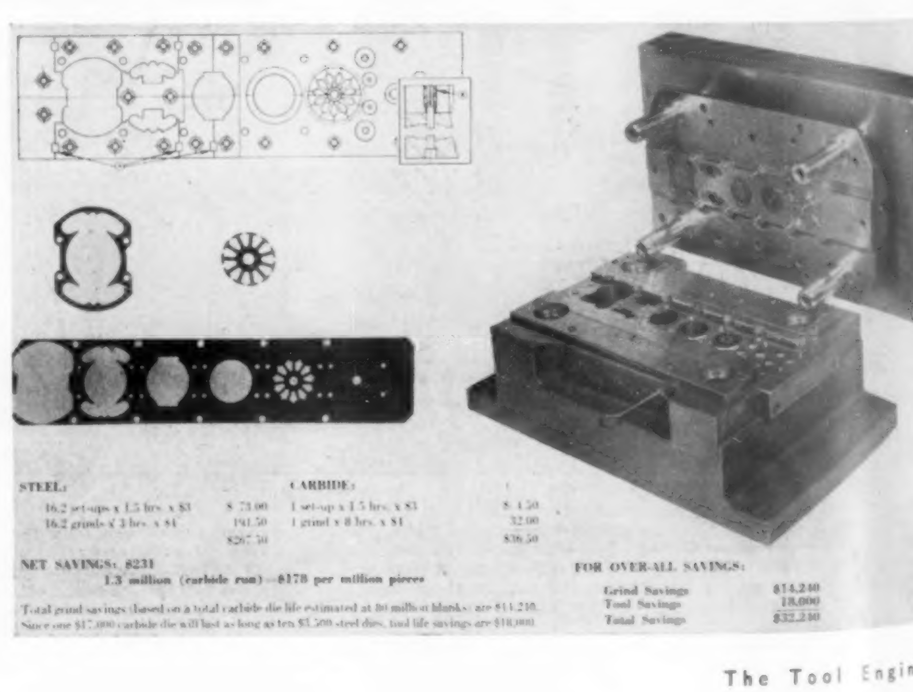


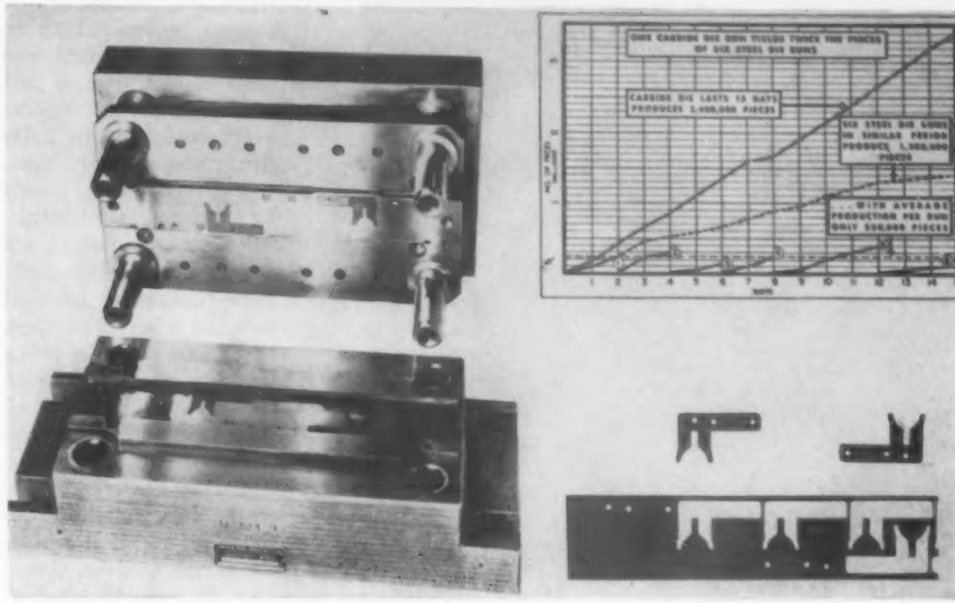
Actually, all that many of these jobs required was a new perspective. Since we are putting in a material which is expected to have long life, why hasten its failure by designing for easy replacement? Let's design these jobs for permanence, and by the time replacement is required we've got our money back many times over, even thought replacement is more difficult. Frequently a design can be established which will permit interchangeabiliy of the carbide details, but it is seldom the same design previously used. There are exceptions of course, and among them are punches and segments in the conventional rotor or stator die, or plain round punches or die buttons.

Sharpening the carbide die, and its general maintenance frequently cause concern to a prospective user. He doesn't have the skilled carbide workers, and he is afraid that his sharpening equipment isn't good enough. This problem is real, and should not be brushed off lightly. He should use maximum care and he should have a good grinder on which to do the job. As he acquires more carbide dies, his skill in servicing them increases to the point where the job is routine.

(Above) Blanking and cutting of E and I laminations are performed on this die, working on 0.014 to 0.025 in. 4½ percent silicon steel strip. Operating on coiled stock, these dies average about one million strokes per sharpening.

(Right) This six station progressive die pierces and blanks armature and field laminations for automobile heater motors. It is one of three identical models. A top-sprung stripper is employed, which in turn is closely fitted to the small perforators to provide support at all times. Guide pins are of the removable expansion type and are fitted to hardened bushings in the top shoe. Material punched is mild silicon motor grade electrical sheet, 0.025 in. thick.



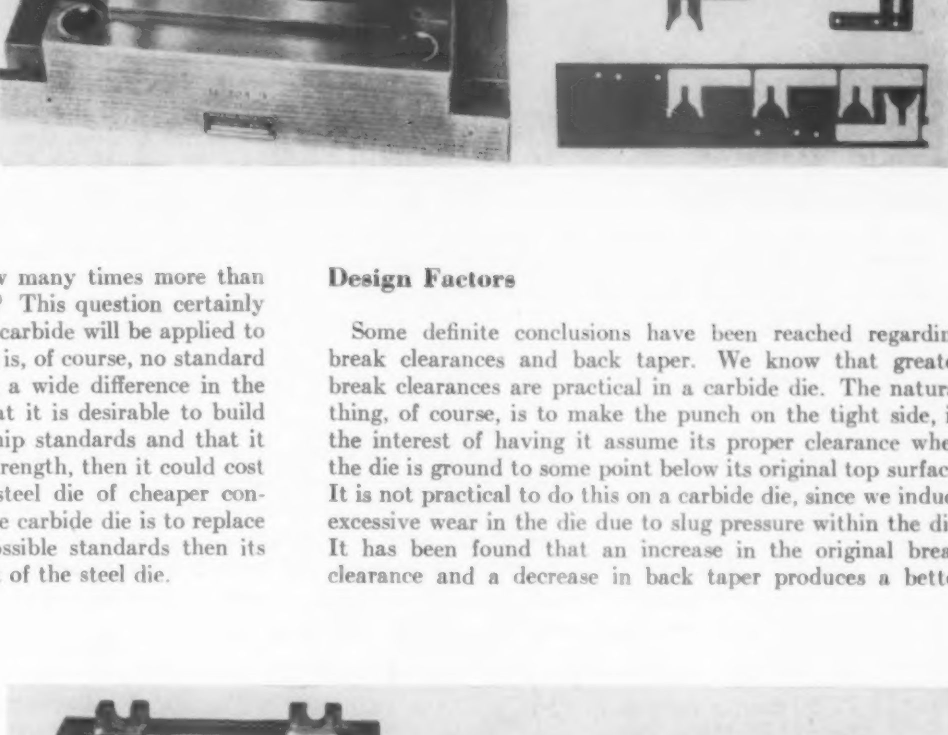


This carbide die is one of three identical dies in operation for an electric clock manufacturer. It has been in operation for more than two years, and has produced the comparison record shown. Note that output per day is more than doubled by the carbide die. Material punched is mild cold rolled steel coils, 0.030 in. thick.

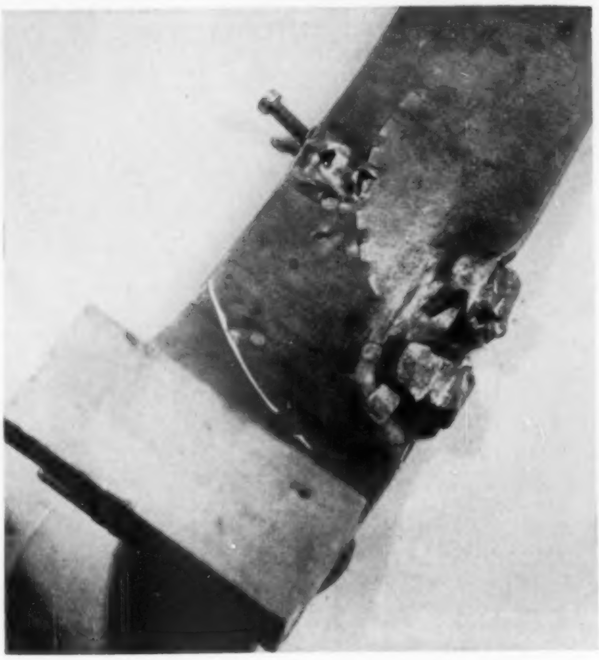
A very common question is, how many times more than a steel die does a carbide die cost? This question certainly has a bearing as to whether or not carbide will be applied to the job under consideration. There is, of course, no standard factor to apply since there is such a wide difference in the price of steel dies. If we agree that it is desirable to build the carbide die to high workmanship standards and that it should incorporate the maximum strength, then it could cost four or five times as much as a steel die of cheaper construction. If, on the other hand, the carbide die is to replace a steel die built to the highest possible standards then its price could be as little as twice that of the steel die.

Design Factors

Some definite conclusions have been reached regarding break clearances and back taper. We know that greater break clearances are practical in a carbide die. The natural thing, of course, is to make the punch on the tight side, in the interest of having it assume its proper clearance when the die is ground to some point below its original top surface. It is not practical to do this on a carbide die, since we induce excessive wear in the die due to slug pressure within the die. It has been found that an increase in the original break clearance and a decrease in back taper produces a better



Shown here are re-punch, or full pierce dies, which pierce the slots and rivet holes in rotor and stator laminations. The blanks are fed into the dies with slide feed mechanisms, and are ejected by knockouts. Finished blanks are gravity-fed to a take-away chute and then in turn to a conveyor belt. Comparison data shown indicate that more than $0.10 per motor is saved by using carbide dies on this job.



It is of irregular section, and has parts more than 1/2 in. thick at the point where the punches started. This unbalanced overload stalled the press. On dissembly the damage was found to be three broken perforators and one broken die section which cost less than $300 to repair. Had conventional construction been used this mishap probably would have wrecked the die.

result throughout the life of the die. This can, of course, be carried too far and we frequently must compromise on what we think is the best clearance in order to make the slugs tight enough to stay in the die. This is especially true on small perforators. We can't establish a standard formula or a percentage factor based on the stock thickness to cover this, since we must consider the punching characteristics of the material we are punching. We have one set of conditions for punching mild strip steel and an entirely different set when we are punching stainless or high-silicon strip or sheet. Our experience with carbide dies leads us to believe that the break clearances established as standard practice on steel dies has never been correct, nor for that matter, has it ever really been true in operation. What I am about to say is true conjecture on our part, but we have come to the conclusion that the break clearance present on a newly-sharpened steel die is substantially increased after the first few strokes. The working surface has been annealed to some degree by the grinding action, probably to a depth of a few tenths of a thousandth, or more. This soft surface quickly wears off and if it adds up to a half a thousandth between the punch and die, then we have increased our break clearance 50 percent on a die where we start out with one thousandth. But at this point the die makes good blanks. Since that soft surface is not present on carbide in seems sensible to incorporate this greater clearance in our specifications. Experience has taught us that break clearances should be greater, whether or not our reasoning concerning steel dies is correct.

Some Notes on The Nitriding of High Speed Steel

By J. G. Morrison
CHIEF METALLURGIST
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The nitriding of finish treated high speed steel tools has been commercially exploited for about the past fifteen years. The process is quite simple, and consists of immersing the high speed steel tools in molten cyanides for varying periods of time at temperatures of from 950 to 1100 deg F, depending on the nature of the tool. When heat treated high speed steel tools are immersed in an aged bath of sodium and potassium cyanides, nitrogen is absorbed at the surface to form quite stable nitrides. The result is a greatly increased surface hardness—from a Knoop microhardness number of about 850 for and unnitrided tool to about 1050 to 1150 for a nitrided tool.

It is not known who first thought of the idea for nitriding high speed steel. It is known that as early as 1914 (1) * the Ford Motor Co. had a number of tools treated in a molten cyandide bath with improvement to the cutting performance of some tools. In 1929 Kinzel and Egan (2) reported that a 0.20 percent carbon, 50 percent vanadium steel heated in a mixture of sodium and potassium cyanides at 860 deg F for two hours, resulted in a hard case of about 0.0005 in. thick.

We would like to interject here our early experience in the nitriding of finish treated high speed steel tools since it is quite likely that it parallels the experiences of others. Our first contact with nitrided high speed steel tools was the result of a suggestion by Gustav Peterson of the Edgcomb Steel Co. Early in 1930 Mr. Peterson had a number of taps nitrided for us by the conventional gas nitriding method. These tools were extremely hard on the surface and very brittle. Considerable exfoliation occurred in transit and, in attempting to scratch common window glass with a 60-deg tooth, spalling took place immediately. In 1934 experiments were initiated in liquid nitriding and discontinued almost as quickly as they were begun. Very brittle tools was the result. However, after an interval of about six months a number of high speed steel tools were rejected by the operating department as being too soft. In an effort to salvage these tools it was decided to heat them in the mixture of cyanides which had been slowly aging in the abandoned pot. Given a 15 minute immersion at 1050 deg F, these tools gave a performance to the satisfaction of the operating department. This reversal of form raised several questions: (a) perhaps the process is primarily applicable to relatively soft tools or, (b) the aging of the bath may have altered the nitriding characteristics. Further investigation showed the latter to be the case and by 1937 a considerable number of tools were being nitrided.

It is perhaps safe to say that today all high speed steel cutting tools which are nitrided in this country are treated in aged molten cyanide baths for from ten minutes to two hours. It is probable that few tools receive more than 30 minutes at about 1025 deg F. The details of the process have been discussed elsewhere (1), (3). Given tools in sufficient quantity, it is relatively inexpensive. It is a proven method and we believe subject to some further refinement and perhaps an even more extended usage.

The successful nitriding of high speed steel tools presupposes initially well treated tools. All high speed steels carburize rapidly under conditions where a highly carburizing potential exists at the superheat temperature. In general, as the tungsten decreases and the molybdenum increases, the rate of carburization (under carburizing conditions) increases; also the retained austenite at the surface becomes more stable to thermal decomposition. Consequently, molybdenum high speed steels treated under conditions where excessive carburization has occurred may retain a considerable quantity of austenite at the surface, even after two or more conventional draws. A high speed steel surface which contains a high percentage of refractory austenite appears to resist the ingress of nitrogen.

It is well known that high speed steel does not retain a keen cutting edge comparable to carbon tool steel. However, when nitrided, high speed steel tends to maintain a keener edge. Certain tools which take light cuts in such fairly abrasive materials as annealed high speed steel are not satisfactory unless nitrided. In such special cases *any* well treated high speed steel adequately nitrided performs satisfactorily. The type of high speed steel in this instance is of passing consequence and the hard nitrided surface is the difference between success and failure.

It is generally appreciated that good tools are compounded of many elements other than the particular high speed steel from which they are made. Not the least are the mechanical conditions under which the tools operate. The introduction and exploitation of carbide as a cutting material has done much to improve machine tools. The realization of more rigid tooling, improvement in machine tool design to the end of better maintained alignment have been in the direction

*The figures in parenthesis refer to references appended to this paper.

TABLE I

Several specimens of A.I.S.I. 4140 steel and 18-4-1 high speed steel gas nitrided for various times.
Effect on the case hardness of nitrided and nitrided and drawn at 1075 deg.F. or 1100 deg.F. specimens.

Specimen No.	Material	Treatment	Gas Nitrided	Case Depth	Subsequent Treatment	Rockwell		
						Core	Case	
						Rc	Ra	Rc
17-1	4140	1525°F-Oil 1125°F-2 hrs.	48 hours 1010 deg.F.	.030"	none	30.6	75.5	47.0
17-1a	4140	1125°F-2 hrs.	48 hours 1010 deg.F.	.030"	1100-1 hr.	29.8	75.5	47.0
17-3	4140	1125°F-2 hrs.	30 hours 975 deg.F.	.018"	none	31.0	74.5	45.5
P-1	18-4-1	2325-Oil	48 hours 1010 deg.F.	.012"	none	63.0	88.6	70.3
P-1a	18-4-1	2325-Oil	48 hours 1010 deg.F.	.012"	1075-1 hr.	63.0	88.3	70.5
P-2	18-4-1	2325-Oil 1050-1¾ hrs.	48 hours 1010 deg.F.	.012"	none	62.5	88.7	70.3
P-2a	18-4-1	1050-1¾ hrs.	48 hours 1010 deg.F.	.012"	1075-1 hr.	62.5	88.3	70.4

of improved mechanics. Consequently, with the improvement in our machine tools we are frequently enabled to use harder and more durable cutting tools of high speed steel.

In general, nitriding has been applied to those tools which take relatively light cuts. The present study is directed toward relatively "deep" cases (depths of the order of about 0.0017 to 0.0025 in.) as a result of nitriding for one to two hours at a temperature of about 1025 deg F. There is some indication that a stress-relieving treatment following nitriding may enable extended usage of the process.

B. I. Kostetsky and G. D. Kuruklis (4) are purported to have obtained a "nitro-cementation" of hardened high speed steel tools as deep as 0.012 to 0.020 in. in 3 to 4 hours at 550-600 deg C (1022-1112 deg F.) The process entails the use of (a) electro-chemical cleaning to assure a receptive metal surface and (b) aluminum shavings are introduced as a catalyst and coke oven or oil gages together with 20-40 per cent ammonia led into the container. The increased depth is claimed to be due to the removal of the active hydrogen atoms which interfere with the penetration of nitrogen.

Several experiments carried out in the gas nitriding of AISI 4140 steel heat treated to approximately 300 Brinell, and in hardeneded and hardened and drawn 18-4-1 high speed steel may be of academic interest. Specimens, approximately ⅜ by ⅝ by 1 in., were ground on a broad surface after heat treatment and then polished as for microscopic examination. They were then gas nitrided for various times and temperatures. The specimens were then nicked in two and one portion drawn in a neutral salt bath for one hour at 1075 to 1100 deg F.

Examination of the Rockwell "A" and "C" impressions (at 100X) on the polished cased surface of the specimens listed in Table 1 shows the following:—The 4140 sample, No. 17-1, nitrided at 1010 deg F for 48 hours shows cracks radiating from the peripheries of the impressions. Specimen 17-la was given the same nitriding cycle but reheated to 1100 deg F for 1 hour in a neutral bath; the Rockwell "A" and "C" numbers of the case were unchanged but the impressions were free from radiating cracks. Specimen 17-3 nitrided at 975 deg F for 30 hours showed both the "A" and "C" impressions to be free of radiating cracks in the as-nitrided condition.

Inspection of the Rockwell "A" and "C" impressions of 18-4-1 specimens P-1, P-la, and P-2 and P-2a showed only slight differences as regards shatter of the "C" impressions and the radiating cracks about the "A" impressions. In clamping the specimens together for the polish preparation spalling of the edges was considerable on the portions nitrided only and much less so on the portions drawn at 1075 deg F.

The hardness numbers on the specimens of 18-4-1 steel given in Table I are to be taken with some reservation because of the cracking and shatter of the impressions; also the Brale mortality is quite high in taking Rockwell "C" impressions on deeply cased high speed steel.

A series of experiments were carried out to determine if any substantial improvement to the impact properties or bend test could be found.

Table II shows the various high speed steels accorded the several tests and the corresponding heat treatment.

Table III lists the impact tests accorded the various steels in the nitrided and stress-relieved condition. Table IV lists the bend tests on 18-4-1 and Type M2 high speed steels as nitrided and after stress relieving. The bend test specimens measured 0.140 by 0.500 by 2 in. This test as a measurement for "toughness" in high speed steel has been investigated by Grobe and Roberts (4).

Table V lists results obtained on Knoop microhardness numbers of the several high speed steel given a two hour nitride at 1025 deg F. Specimens 1 in. long were nicked in two and one portion given one hour in a nitrate-nitrite bath

TABLE II

Material	C	Cr	W	V	Mo	Co
18-4-1	.74	4.07	18.08	1.04	.44	
Type "M2"	.82	4.16	6.26	1.82	4.98	
Type "M1"	.73	3.82	1.45	1.17	8.40	
Mo-V	.89	3.88	....	1.90	8.27	
Super H.S.	1.50	4.86	12.25	4.95	....	5.03

All specimens were treated in electrode salt bath furnaces as noted below:

Material	Preheat	Superheat	Quench	Double Draw (air draw)	
18-4-1	1550°F	2325°F	1125°F	Finish cool in air	1025°F, 1¾hrs.
Type "M2"	1500°F	2210°F	1125°F	Finish cool in air	1025°F, 1¾hrs.
Type "M1"	1500°F	2180°F	1125°F	Finish cool in air	1025°F, 1¾hrs.
Mo-V	1500°F	2210°F	1125°F	Finish cool in air	1025°F, 1¾hrs.
Super H.S.	1500°F	2250°F	1125°F	Finish cool in air	1025°F, 1¾hrs.

at 1000 deg F. The oxide-coated portions were descaled in a sodium hydride bath at 700 deg F. Comparative tests show a fairly uniform pattern in that the hardness is somewhat lower on the companions drawn at 1000 deg F.

Nitriding of Production Tools and Gages

Nitriding is by no means a cure-all. The effect of a nitrided surface is usually evaluated by practical application and the surprises are often as frequent as the headaches. Some practical applications of the nitriding of fully treated high speed steel tools and gages follows:—

1. Reamers: High speed steel reamers are a good example of nitriding. Reamers are usually nitrided for 30 minutes at about 1025 deg F. As compared to reamers not nitrided, as much as double or quadruple the production is often found.
2. Taps: about 10 to 20 minutes nitriding at 950 to 1050 deg F is usually good practice when tapping steels. A longer nitride of 30 minutes or even an hour when tapping cast iron or weak abrasive materials such as plastics, etc., often results in a much improved production.
3. Twist Drills: A number of tests have been run on twist drills using the 1 hour to 1½ hour nitriding treatment followed by reheating in a nitrate-nitrite bath at 1000 deg F for 1 hour. Production increases have been consistant in drilling steels in the annealed and heat treated condition and also cast iron.
4. Lathe centers made of high speed steel nitrided for 1½ to 2 hours show a consistent improvement in life—of the order of three to four times that of an unnitrided center.
5. Nitrided gages of high speed steel have been used to a rather limited extent. In our experience nitriding has been confined to simple flat locating gages. Many of these gages have been in use since 1941 and are still in service. Gages previously made of oil hardening tool steel lasted from 2 to 3 years. These gages are nitrided at 950 deg F for 30 minutes for a case depth of about 0.0004 in. Compensation for the slight change in size is made of the order of about 0.00005 in.
6. Nitrided hobs for milling high speed steel have shown a much improved life for a number of years. Even hobs made of the "super" high speed steel (1.50 per cent carbon) having a Rockwell "C" of 67 have shown double the life of the same steel not nitrided. In this case it is quite probable that some grinding damage was corrected in the nitriding treatment as this steel is quite difficult to grind.
7. Profiling mills—High spiral, no-clearance mills for sizing by the removal of 0.001 in. to 0.002 in. in heat treated 4140 steel have consistently performed 50 percent better than unnitrided mills. Relatively deep slots are profiled and a high degree of accuracy maintained.
8. Hand and machine graduating tools used on material of approximately 300 Brinell have outperformed unnitrided tools as much as 10 times.
9. Counterbores used on annealed high speed steel and heat treated 4140 have shown at least twice the life of unnitrided tools. Counterbores are nitrided for 30 minutes at 1025 deg F. Experiments are in process using the 2 hour nitride. Counterbores being piloted, excellent mechanical conditions prevail.
10. Shell mills, shaping tools and milling cutters nitrided for 1 to 2 hours followed by the reheating to 1000 deg F are in process of trial.

Test Results

1. Impact tests and bend tests show no significant improvement when nitrided specimens are compared with nitrided and stress-relieved companion specimens. There is a slight improvement as regards the magnitude of the radial cracks around Rockwell "A" and "C" impressions; also less tendency to minute spalling of the edges in the polish preparation. It has also been observed

TABLE III

Impact (unnotched Izod) values of various high speed steel in (1) the as quenched and drawn condition, (2) after nitriding at 1025 deg. F. for one hour and (3) after nitriding followed by several "stress relieving" treatments. Nitriding bath contained 9.5 per cent (CNO).

	"18-4-1"		Type "M2"		Type "M1"		Mo-V		"Super" HSS	
Treatment	Impact ft. lbs.	Rock. "C"	Impact ft. lbs.	Rock. "C"	Impact ft. lbs.	Rock. "C"	Impact ft. lbs.	Rock. "C"	Impact ft. lbs.	Rock. "C"
As Quenched and Drawn	33.0	64.6	42.0	64.7	34.0	64.2	...	...	16.0	66.6
	28.0	64.8	35.5	64.6	34.5	64.4	...	...	16.0	66.7
	29.0	64.6	44.5	64.5	27.0	64.3	...	...	18.0	66.8
Nitride-1 hr.	7.5	64.1	11.0	64.0	8.0	63.7	9.0	63.4	5.0	66.5
	8.5	64.2	11.0	63.8	9.0	63.8	9.5	63.4	7.5	66.5
	8.0	64.2	9.5	64.1	10.0	63.8	10.5	63.4	6.0	66.4
Nitride-1 hr. +700°F-1 hr.	10.0	64.2	9.0	64.1	9.5	63.8	...	...	...	...
	10.0	64.2	8.0	64.2	12.5	63.9	...	...	...	...
	7.5	64.2	11.0	64.0	9.0	63.8	...	...	...	...
Nitride-1 hr. +1000°F-1 hr.	6.0	63.7	7.0	64.0	10.5	63.7	5.5	63.0	5.0	66.2
	6.0	63.7	10.0	64.1	6.5	63.3	8.5	63.2	5.0	66.3
	8.5	64.0	5.5	63.9	12.5	64.0	7.5	63.0	4.5	66.2
Nitride-2 hrs. +1000°F-1 hr.	4.0	64.2	4.5	63.7	5.0	63.7	...	...	...	...
	6.5	64.0	9.0	63.9	6.5	63.8	...	...	...	...
	4.5	63.9	7.0	63.9	9.0	63.5	...	...	...	...
Nitride-2 hrs. +1000°F-2 hrs.	7.0	63.5	9.0	63.5	4.0	63.3	...	...	3.5	66.1
	4.0	64.1	4.5	63.5	4.5	63.0	...	...	4.0	65.8
	4.0	63.7	4.5	63.7	7.5	63.3	...	...	4.0	66.1

All specimens were ground after hardening and double draw treatment except the "super" high speed steel which was ground to size before treating.

that on tools which have been nitrided for 1 to 2 hours that the tendency to minute spalling of the cutting edges in regrinding is lessened in those tools which are subsequently drawn at 1000 deg F.

2. An aged mixture of sodium and potassium cyanides, containing 8 percent cyanate (CNO), shows a quite comparable erosion for the various high speed steels tested.

3. The 18-4-1, Type M2, Type M1 and the molybdenum-vanadium steels appear to respond equally as well to the nitriding treatment. The nitrides of the several high speed steels appear to be very stable as evidenced by the slight change in the microhardness numbers of the nitrided specimens compared with the specimens nitrided and drawn at 1000 deg F. This retention of hardness at 1000 deg F is also typical of the gas nitrided Nitralloy steels. (6)

4. A number of tests are being conducted at the present time and show promise. Further tests will necessarily have to be carried out in order to determine if the stress relief following nitriding is a significant improvement.

Acknowledgement—Thanks are due the Vanadium Alloys Steel Co. for conducting the impact and bend tests; as well as the microhardness tests.

References

(1) **Morrison, J. G. and Gill, J. P. *Transactions* A. M. M. Vol. XXVII, 1939. "Introductory Study of the Nitriding of Hardened High Speed Steel by the use of Molten Cyanides."**

(2) **Kinzel, A. B. and Egan, J. J. *Transactions* American Society for Heat Treating, Vol. XVI, 1929.**

TABLE V

The microhardness (Knoop) numbers of various high speed steels (1) nitrided for two hours at 1025 deg.F. and (2) after heating in a nitrate-nitrite bath at 1000 deg. F. for one hour.

Type H.S.S.	Specimen	Nitrate-Nitrite Bath	Microhardness Numbers Load in Grams		
			500	1000	2000
18-4-1	10	....	1200	1114	1071
	10a	1000 deg.F.	1167	1095	1033
"M2"	30	....	1200	1155	1098
	30a	1000 deg.F.	1167	1134	996
"M1"	50	....	1167	1134	1033
	50a	1000 deg.F.	1140	1076	1033
Mo-V	71	....	1167	1176	1071
	71a	1000 deg.F.	1112	1076	1045

(3) **Morrison, J. G. A. S. M. E. Paper Number 44-82, 1944. "Nitriding of Hardened High Speed Steel Tools."**

(4) **Kostetsky, B. I. and Kuruklis, G. D. *Stanki I Instrument*, No. 6, 1946.**

(5) **Grobe, A. H. and Roberts, G. A. *Transactions* A. S. M. Vol. 40, 1948. "The Bend Test For Hardened High Speed Steel."**

(6) **Homerberg, V. O. "Nitralloy & The Nitriding Process." The Nitralloy Corp. 230 Park Ave., New York, N. Y.**

TABLE IV

Bend tests on (1) Nitrided and (2) Nitrided and Stress Relieved 18-4-1 (P) and Type M2 (M) High Speed Steels.

Spec. No.	Nitride 1025°F Hours	Stress Relief Hours	Yield Strength P.S.I.	Bend Strength P.S.I.	Total Deflection Inches	Plastic Deflection Inches	Rockwell Torsion Side	"C" Compression Side
P-1	1	none	none	303,000	.046	none	64.5	64.2
P-2	1	700°F-1	none	274,000	.040	none	64.7	64.5
P-3	1	1000°F-1	none	294,000	.044	none	64.2	64.1
P-4	1	1000°F-2	none	231,000	.035	none	63.9	63.7
P-5	2	none	none	253,000	.039	none	64.3	64.3
P-6	2	700°F-1	none	256,000	.040	none	64.5	64.6
P-7	2	1000°F-2	none	253,000	.041	none	64.3	64.2
P-8	2	1000°F-2	none	194,000	.032	none	64.0	64.0
P-9	1	1000°F-1	437,000	563,000	.092	0.005	64.4	63.9
P-10	1	1000°F-1	none	224,000	.035	none	64.7	65.1
P-11	2	1000°F-1	427,000	540,000	.086	0.002	64.3	63.9
P-12	2	1000°F-1	none	215,000	.033	none	63.5	64.1
M-1	1	none	none	260,000	.040	none	63.8	64.0
M-2	1	700°F-1	none	292,000	.046	none	63.8	64.0
M-3	1	1000°F-1	none	288,000	.044	none	64.5	64.4
M-4	1	1000°F-2	none	291,000	.044	none	63.2	63.2
M-5	2	none	none	286,000	.043	none	63.3	63.3
M-6	2	700°F-1	none	286,000	.044	none	64.5	64.5
M-7	2	1000°F-1	none	195,000	.032	none	64.5	64.5
M-8	2	1000°F-2	none	216,000	.035	none	62.7	62.6
M-13	1	1000°F-1	437,000	621,000	.111	0.015	63.7	63.4
M-14	1	1000°F-1	none	294,000	.046	none	63.4	63.8
M-15	2	1000°F-1	437,000	587,000	.100	0.008	63.3	62.9
M-16	2	1000°F-1	none	268,000	.041	none	62.9	63.4
M-9	1	1000°F-1	none	292,000	.045	none	64.4	64.6
M-10	1	1000°F-1	none	294,000	.046	none	63.4	63.4
M-11	2	1000°F-1	none	248,000	.041	none	63.3	63.3
M-12	2	1000°F-1	none	294,000	.045	none	63.3	63.2

*- Eight specimens P-9 to P-12 and M-13 to M-16 were ground on top surface in reference to number on end before nitriding. All specimens were .015" full to size on thickness before nitriding. The "P" specimens were .005" full to size on width and the "M" specimens .015" full to width. After stress relief specimens were ground to size removing metal from the three sides not ground before nitiriding. The nitride case on specimens P-9, P-11, M-13 and M-15 were tested with the case in compression; on specimens P-10, P-12, M-14 and M-16 the case was in torsion.

** Specimens M-9 and M-11 were vapor blasted before stress relief and specimens M-10 and M-12 were vapor blasted after stress relief.

Hard Chrome Plating

By Brayton A. Taylor

VICE PRESIDENT

CHROME ELECTRO-FORMING CO.

HARD CHROME PLATE is applied to new tools and gages for securing increased production life; to bring undersized used tools back to original specified dimensions or to new requirements, and to provide abrasion-resistant wear surfaces on many types of machined or formed parts and products.

The typical hard chrome plating process deposits relatively thick coatings of from 0.0005 to 0.01 inch.[1] It is applied directly to the steel or other base metal, as contrasted to decorative coatings, usually not more than 0.00005 inches thick and applied over some preparatory coating. The final coating, in either case, has a hardness from 850 to 950 Brinell.[2]

The resultant surface may be described as soapy or slippery, with a low coefficient of friction and hence a great reduction in the tendency to galling in close-fitting elements moving in relation to each other.

Preparing Base Metal for Plating

The preparation of the base metal is a most important pre-requisite to successful hard chrome plating. The metal must be free from all scale, burrs, burns, and from metal (commonly called "fuzz") turned over during grinding. It must also be free from deposits left as a result of secondary heat treatments such as cyanide baths.

The smoother the finish before plating, the better will be the results after plating. Even when applied in the thickness common to this process, hard chrome plating will, when viewed under suitable magnification, show the same surface characteristics as were left on the unplated base metal.

The presence of high and spots or areas on the base metal before plating invites early peeling, chipping and flaking of the plate under pressures encountered in service. As an analogy, place a piece of plate glass on a somewhat distorted or uneven surface. Apply relatively slight pressure and the glass will break. Place the same type and thickness of glass plate on a truly flat surface and it will not break under several tons pressure.

Another important requirement for good hard chrome plating is that the base metal be hard enough to support the plate. Providing the surface has been properly prepared; the plate will adhere as well to a base metal of Rockwell 40C or lower as to metal of Rockwell 64C or higher. However, the compressive action of forces locally applied in a plated surface tends to drive the plate into the base metal. If the base metal yields under the pressure, the plate will itself bend or deform, with very probable early failure.

In a nutshell, *hard chrome plate can only be as good as the surface to which it is applied.*

Importance of Plating to Size

A tool or part of far superior service life is assured if no finish grinding is done on the hard chrome plate. In proof, extensive tests have been made on plated steel of the same grade and hardness. As against pieces plated oversize and then ground to size, pieces which were plated to size and therefore not finish ground showed at least twice the wear life.

Among other probable reasons for this, is the possibility that grinding after plating may unduly thin and weaken the plate at spots where the base metal was high due to poor finishing. Whatever the reasons, it is both desirable and economically possible to get parts so accurately plated to size that subsequent finishing is usually not necessary.

Ball Bearings

Balls can be plated with 0.006 in. of hard chrome and held within bearing manufacturers' tolerances. One interesting application is their use as checks in check valves employed in underground services involving severe corrosion and abrasion conditions. The balls are tested for smoothness and concentricity by turning the ball on its seat while a vacuum is pumped. if any leakage results, the ball is rejected.

[1] TOOL ENGINEERS HANDBOOK, 1st ed., p. 1229, American Society of Tool Engineers. Published by McGraw-Hill Book Co., Inc., New York, N. Y., 1949.

[2] METALS HANDBOOK, 1948 ed., p. 719, The American Society for Metals, Cleveland, O., 1948

Outboard Cylinders, Cylinder Bores, and Gun Barrels

Chrome plating of outboard cylinders has permitted a one-third increase in the rpm. A coating of 0.0005 in. of hard chrome in cylinder bores enabled the rpm to be increased from 6,100 to over 7,000. Gun barrels have been plated in lengths up to five feet, with no subsequent grinding or lapping required, and permitting a material increase in the bullet's velocity.

Powdered Metal Dies

In one case on record, 6,000 bushings of an extremely abrasive material were produced by unplated punches, dies and pins. After hard chrome plating, 45,000 of these bushings were produced, with all of the wear still carried by the plate.

Taps

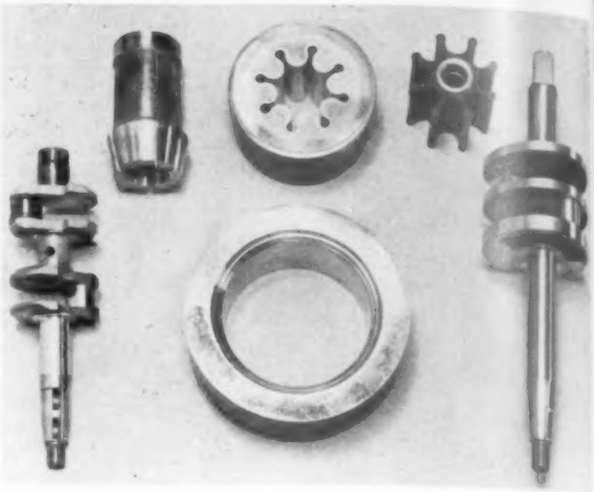
Hard-chrome-plated taps, for use on zinc, magnesium, aluminum, brass and bronze, cast iron, plastics, and on die castings and steel forgings, have shown ten times the life of unplated taps.

Extruding Dies

In one application, drive shafts were extruded through steel dies at 180 tons pressure, with a yield of 2,000 pieces per die. With 0.0005 in. of chrome plating and the same applied pressure, die life has been extended to 34,000 pieces, after which the worn chrome plate is stripped off and replating is done to size.

Drill Jig Bushings

It has been found that, by grinding and lapping drill jig bushings 0.001 in. oversize and then hard chrome plating back to size, wear life is greatly increased. In one automotive application, this practice permitted a 500 percent increase in number of holes drilled, as against non-shrink chromium steel unplated bushings. The plating tolerance on hole size can be held to tolerance specifications listed in American Standard ASA B5.6—1941, and closer if necessary.



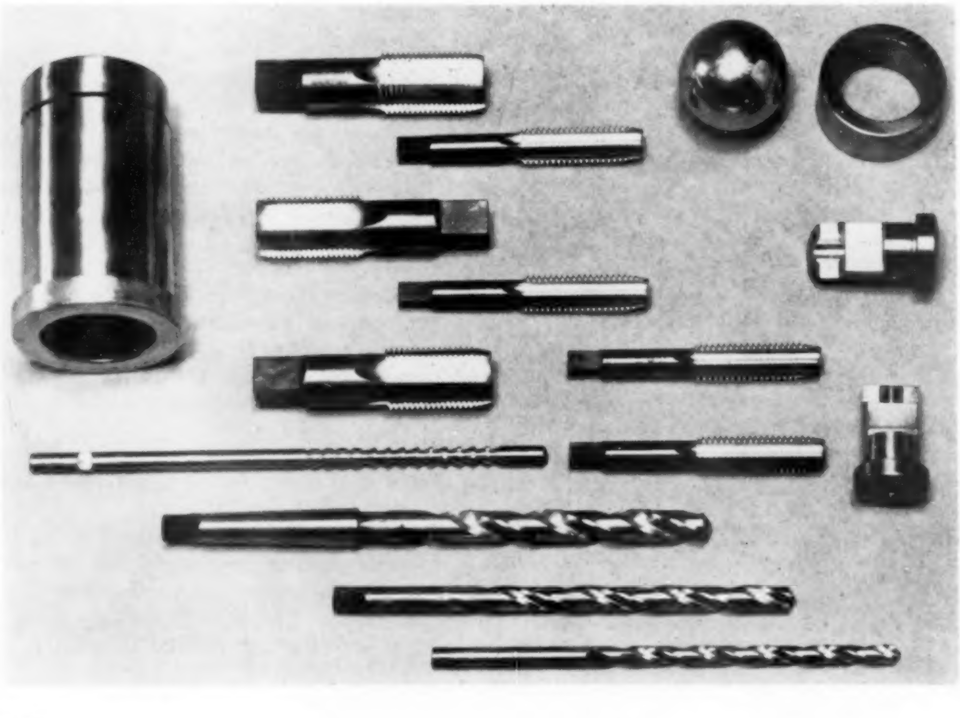
Hard chrome plating of wear parts such as the crankshafts shown above more than pays for itself in longer service. Dies, such as those shown in center, are successfully hard chrome plated, particularly for extrusion applications.

Thread Gages

Good practice is to precision grind and lap the gage from 0.003 to 0.004 in. below basic gagemakers' tolerance, then apply hard chrome plate as close to the high tolerance as possible, so that no grinding or lapping is required after plating.

Provided that the gage elements are not worn down more than 0.005 in. under basic size, plated gages can be effectively salvaged for 50 percent of their initial cost, by stripping off the worn plate and then replating to size. Such reclaimed gages can and should carry the guarantee of a new gage.

Punches, dies, and other tools can be similarly reclaimed. It is recommended that the "pulling" tolerance be predetermined for each such tool. If this tolerance for a certain tool is, say, 0.003 in., then that tool should be pulled off the job when it has worn 0.003 in. under the basic size, and



Taps, drills and gages form a wide field for hard chrome plating. Reclaimed and plated gages can sometimes carry the guarantee of a new gage; drill life has been increased five to eight times through plating.

should then be ground and lapped a few ten-thousandths of an inch below the pulling tolerance. It is then plated back to basic size.

Broaches

Broaches that have been worn down 0.0005 to 0.0007 in. undersize have been plated back to size, and then yielded from two to three times the life of the original unplated broach. On broaches having a burnishing section, up to 700 percent increase in life has been attained, depending on the metal being worked and on the amount of metal left in the hole to burnish.

Drills

Due to its low coefficient of friction, hard chrome plating improves chip flow and minimizes galling. Since drill life depends on the land as well as the flutes standing up, plating greatly increases drill life through the virtual elimination of galling, which would require a portion of the drill tip to be cut off so that the drill will cut to size.

In drilling cast iron, with an increase in feed equal to that for carbide drills, hard chrome plating has increased drill life from five to eight times that for unplated drills. The plated drills showed none of the burning that would occur on unplated high-speed-steel drills if run at carbide speeds.

Burnishers

The high heat frequently generated in burnishing can easily cause an expansion that would throw the burnished piece out of specified tolerance. The soapy texture of a chrome plated burnisher surface, with its minimum galling action, causes less frictional heat to be generated. A series of tests on a specific application showed a 9-hour life for unplated high-speed burnishers, a 31-hour life with burnishers heavily chrome-plated and reground to size, and a 59.7-hour life for burnishers hard chrome plated to size.

Plastics Molds

The service conditions for the molding of plastics involve heavy wear, harsh abrasive materials, chemical corrosion, high pressures and temperatures, and close tolerances.

Hard chrome plating from 0.0003 to 0.0005 in. thick provides a smooth, dense surface that stands up remarkably under all these adverse factors. There is better flow of compound; higher finish on molded pieces and easier extraction from the mold; better maintained uniformity of molded pieces, and no need of frequent repolishing.

From the salvage point of view, there are marked economies in the hard chrome plating, back to size, of such elements as cavities, side walls, knockout pins, hole-forming pins, monogram pins, insert holders, and curing forms.

Piston Rings

In most cases, the compression ring and especially the top rings operate with very little lubrication. This condition, long continued, can cause the rings to feather or scuff, with resultant cylinder wear, high oil consumption, and low efficiency. Bad dusting conditions will also contribute to ring and cylinder wear.

Hard chrome plating on the piston ring cylinder-contacting surface permits the ring to seat itself quickly. The high hardness of this plate tends to condition the cylinder wall during the seating-in period, so as to achieve extremely well-matched surfaces. The life of plated rings is about five times that for unplated rings, and the cylinder wear is reduced by two-thirds. Only the top ring of each piston need be chromium plated.

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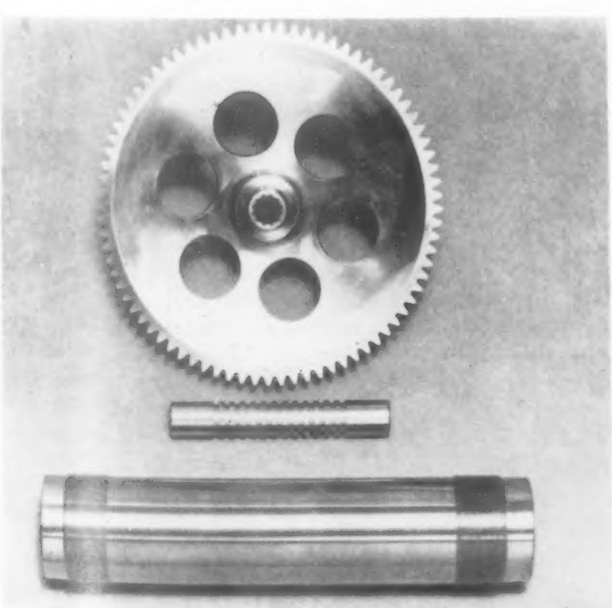
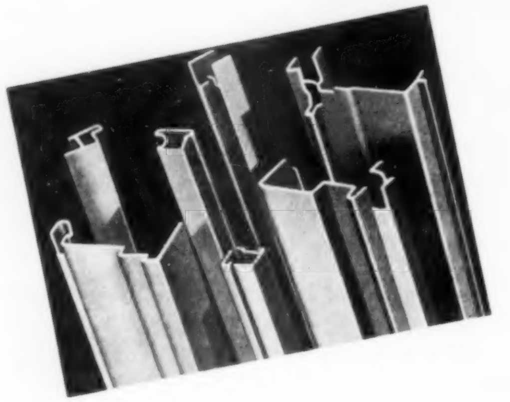


(Left and right). One of the advantages of hard chrome plating is the resultant soapy surface, which minimizes galling on such tools as drills and burnishers. Increased wear resistance on automotive parts such as valves, steering gear forgings and gears has made plating an economic success. Piston pin life is increased by four times by plating, and cylinder wear reduced by two-thirds.



By E. J. Vanderploeg
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Cold Roll Forming of Metals

COLD ROLL FORMING has been defined as a process whereby a flat strip of metal, by passing through a series of rolls arranged in tandem, is progressively formed into the ultimate desired shape. Ordinarily the metal requires no heating or heat treatment before, during or after forming. The number of rolls required is determined by the character and intricacy of the shape, also the thickness and kind of material to be formed; hence, it is customary, where a number of different shapes are to be made on the same machine, to use one having a base long enough to accommodate the maximum number of rolls ever likely to be required for any shape likely to be made on that machine.

The Machines

Because of the necessity for great accuracy and uniformity in most roll-formed shapes, the machines as well as the tooling must be designed to very close tolerances. They must also be quite sturdy so as to withstand, for a period of many years, the bending stresses, wear and tear incident to continuous operation at a high rate of speed, in forming millions and millions of feet of sheet and strip metal.

The typical roll forming machine consists of a welded steel base on which is mounted a series of two, three or more identical roll stands, each designed for holding one pair of rolls. For forming light, narrow shapes, the so-called outboard type machine is often used. In this the roll spindles are supported only at one end, affording better visibility and access to the machine in changing and adjusting the tooling. However, the pressures required in forming most commercial shapes are such that they impose on the spindles bending stresses which can best be withstood by supporting them at both ends in adjustable anti-friction bearings. The latter also provides the means of keeping the spindles in accurate alignment. This (Fig. 1) is known as an inboard type machine.

The inboard type of machine as made by at least one manufacturer, can be quickly converted to an outboard type, simply by pushing the outboard housings in against the rear housings.

The gearing in roll forming machines consists of a hardened steel worm and high strength bronze worn gear, the latter mounted on the fixed lower roll spindle. As the upper roll spindle has to be adjustable to different levels to accommodate rolls of different diameters, it is driven through a toggle gear arrangement which permits making these adjustments without sacrifice of the full pitch-line mesh of the drive gears. For applications in which these limits have to be exceeded, the gear housings are set back and the spindle driven through jackshafts and universal couplings. This type has been made with spindles up to 15 in. diameter, for cold forming structurals up to ½ in. thick and pipe up to 20 in. diam from plate up to ¾ in. thick by about 94 in. wide. These machines are used in connection with electric-weld pipe and tube mills.

When the sections to be formed have deep profiles, such as a deep channel, box and tubular shapes, the upper, or male, rolls have a greater pitch or driving diameter than the lower ones. The pitch diameter is defined as the widest and most nearly horizontal area of the roll profile. This area is important in providing most effective, balanced traction for the stock. In deep forming, the male rolls, being of greater diameter, and therefore having a greater peripheral speed than the lower, will exert a greater pull on the stock. This will result in excessive friction and heat, scoring of the stock and excessive wear of the rolls. Leading makes of machines are available with different gear ratios for the upper and lower spindles, so as to equalize differences in peripheral roll speeds. For machines intended primarily for forming relatively flat shapes, machines with equal gear ratios are obtainable, although the unequal gear ratio is preferable because it is equally suitable for forming both deep and flat profiles.

A question which may occur to many of you is this: If the unequal gear ratio is successful in forming both relative flat and deep profiles, how can it be that the equal gear ratio machine is good only for forming the shallow ones? Fig. 2 is an attempt to explain the difference by two simple cross section drawings. On the left is a cross section of a pair of

rolls of equal pitch diameter, mounted in a machine with equal gear ratio for forming a shallow channel. The pitch diameters of the upper and lower rolls here are identical; that is, the pitch diameter lies midway between the upper and lower spindle.

Assume a channel to be formed with particularly deep flanges; it can be seen from the drawing that because of lack of headroom this would be impossible. The flanges would strike the spindles shortly after they have been bent up a little better than halfway towards the perpendicular.

Compare this with the drawing on the right, which illustrates the same pass in an unequal gear machine, forming an angle of the same width but with flanges twice as deep. The pitch diameters of the rolls here are placed way below the center line between the top and bottom spindles, and the gear ratio is so fixed that the surface speed of the large upper roll is identical with that of the smaller, lower roll. By this arrangement enough space has been gained to make it possible to form channels and other profiles with flanges or legs much deeper than with the equal gear arrangement shown on the left.

In designing and making rolls for all profiles, whether deep or shallow, to be made on a machine with unequal gearing, it is necessary only to make sure that the diameter ratios between the upper and lower rolls will be the same as in the original set of rolls for which the gearing was first designed. By doing so, the surface speed of the upper and lower rolls at the pitch line will remain the same whether shallow or deep profiles are to be formed.

The worm shafts of individual roll stands are interconnected by means of flexible couplings and are driven through V-belts from a motor mounted slightly to the rear of the entry end.

For any of the four standardized basic sizes of forming machines, the roll stands are interchangeable. On the spindles can be mounted the main forming rolls and spacers for any section regardless of profile, kind of stock, width and thickness, coming within the rated capacity of the machine. There is one possible exception, namely, that deep sections should preferably not be formed on machines with equal gear ratios. However, with an unequal gear ratio machine, both shallow and deep sections can, as already mentioned, be formed.

It follows that all parts of any roll stand of a given size and gear ratio are interchangeable not only with the corresponding parts in the other roll stands, in the same machine, but also in other machines of the same size, make, and gear ratio. As the wear and tear on the machines is ordinarily very small, the interchangeability of parts makes repairs and replacements easy, with a minimum of spare parts. Where several machines of the same basic sizes are in use, it is desirable to carry in stock one complete extra roll stand. This can in a few minutes replace any roll stand on the machine which may cause trouble. In this way, one need not hold up production while trying to locate the exact

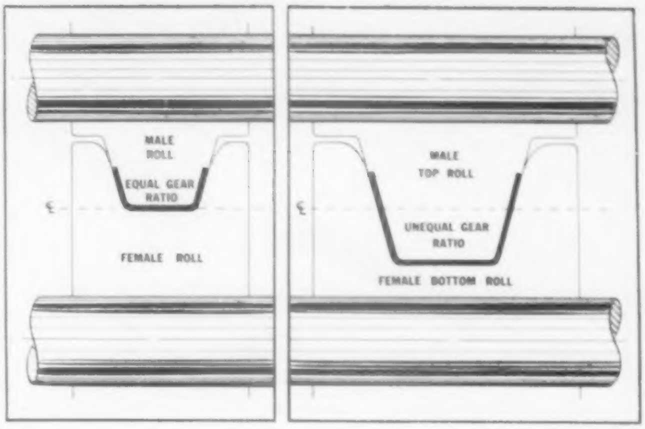


Fig. 2. Principle of application of the unequal gear ratio in cold roll forming machines is shown in the two diagrams above.

source of the trouble and dismantling the entire assembly in order to replace any part thereof.

Forming Bright and Pre-coated Stock

When roll forming is not to be followed by other operations, such as trimming and forming the ends, welding or bending, it is common practice to use cut lengths or blanks and even coiled stock which have already been given the finish ultimately desired. As the change of profile between roll passes is limited, the roll pressures, in cold forming light gauges of metal, are low enough to permit successful forming on a large scale of galvanized, electro-galvanized and electro-plated stock. Metals which have been subjected to mechanical and chemical surface treatments such as buffing, polishing or burnishing may also be cold roll-formed successfully without objectionable marring of the surface.

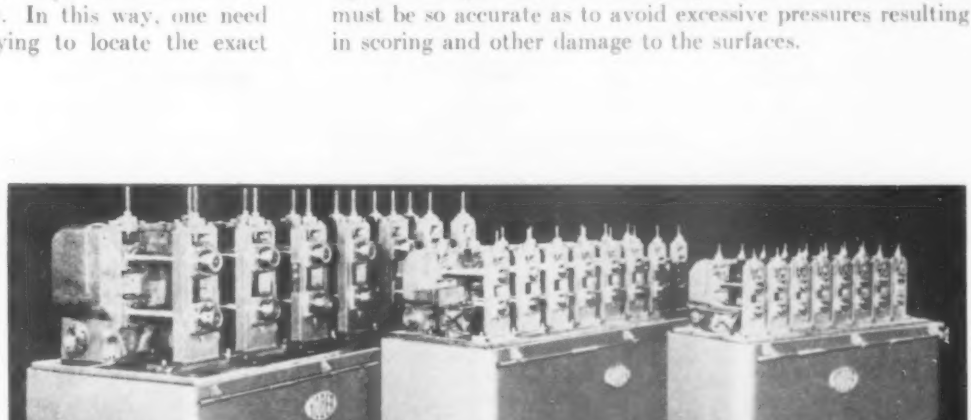
Hot-dipped galvanized stock is being extensively used in cold roll forming, but is subject to greater limitations than are the other finishes just mentioned.

Ordinary paint, enamel, and other organic finishes are not well adapted to cold roll forming. However, in recent years, a number of organic coatings have been developed which will successfully withstand the stretching at sharp bends, as well as the pressures and wiping action of rolls used in cold forming.

Progress is constantly being made along these lines to improve and broaden the use of organic coatings in cold forming applications.

The limitations in general apply to corner radii, depth of profiles and thickness of stock, but are sufficiently broad to permit the cold roll forming on a very large scale of metal trim, mouldings, and building components. Invariable requirements are, however, that rolls must be accurately designed and ground, and their adjustment in the machine must be so accurate as to avoid excessive pressures resulting in scoring and other damage to the surfaces.

Fig. 1. In the inboard type of forming machine shown at right the spindles are supported at both ends in adjustable anti-friction bearings.



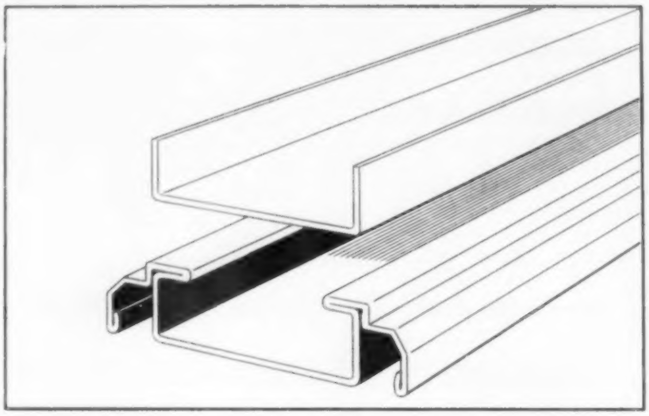


Fig. 4. In designing rolls, the open side of the section to be formed is generally made to face up, as shown above.

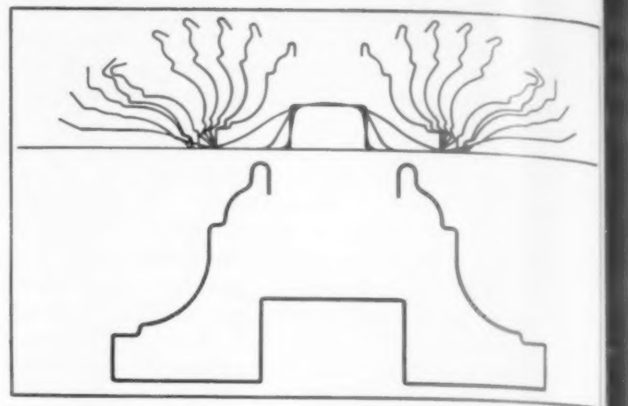


Fig. 5. This flower of the successive roll passes required to produce a form aids in development of the finished design.

Tooling for Roll Forming

First and most essential in tooling for cold roll forming are, of course, the main, or driven, rolls, with the spacers for holding them in proper lateral alignment on the spindles. Fig. 3 shows a standard size roll forming machine with rolls for making the side and end sections for burial caskets formerly made in press brakes.

Depending on the character of the shape to be formed, there may also be a pair of entry rolls or a guide to keep the stock, as it is fed into the machine, in proper alignment with the first pair of forming rolls; also idler rolls, bar guides, or shoes for pinching in of edges and also to prevent vertical or horizontal deflection of the stock in its passage between successive roll stands. The idler rolls may also be designed to exert pressure from the sides, as an aid in forming the vertical surfaces of deep sections, such as channels and box shapes. Finally, at the exit end, a straightening guide, to prevent curving and twisting of the shape as it leaves the machine.

Small rolls or dies may also be provided for curving, coiling or ring forming; dies for cutting to length, perforating and notching the ends. These latter are mounted in an automatic flying cut-off machine installed in line with the forming machine. There may also be rolls for making lock-seam tubing; cutters for trimming stock to the exact width required; embossing rolls; in fact, a number of attachments with tooling may be provided for performing operations other than strictly roll forming, with little or no increase in labor costs or reduction of speed.

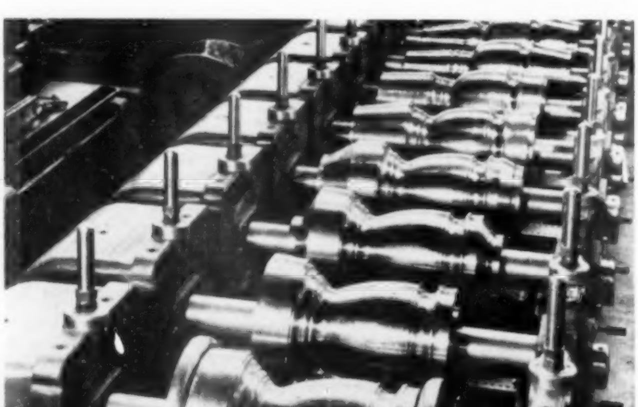


Fig. 3. This standard-size roll forming machine is set up for forming the sides and ends of burial caskets.

Designing Main Rolls

In designing the main rolls, the open side of the section to be formed is generally made to face up; that is, the edges of the strip are beat upwards rather than downwards, as shown in Fig. 4. When the profile is to have openings facing both up and down, the larger or more central opening is usually made to face up.

As a preliminary to designing a set of rolls by the most advanced method, one makes a rough layout or "flower" (Fig. 5) of the successive roll passes, after first establishing a horizontal and a vertical guide line for developing the profiles from the flat strip to the finished shape.

In regard to the guide lines, one is known as the horizontal pitch line, the other as the vertical pass line. The former is placed at the most advantageous level, at or near the lowest point of the shape to be made, and extends in a straight, almost horizontal line through from the first to the last roll pass. This line establishes the pitch diameters of the male top rolls and the female bottom rolls respectively. In the case of forming a simple angle, the pitch line would be at the bottom, in other words, it would correspond with the outside corner of the angle which, in this case, would be the lowest point in forming.

The vertical pass line intersects the horizontal pitch line, or vice versa, depending on which is made first.

As forming in the first roll pass generally starts near the middle of the strip and in the following passes progresses toward the outside edges, the vertical pitch line for any given section is established as the central starting point or dividing line with reference to the number and severity of all the bends to be made on either side. The object is to balance or distribute the amount of forming work to be done by the rolls as equally as possible to the left and right of this centerline.

In the case of the angle, it would be at the exact center of the strip, while in the window screen section in Fig. 6 it would be off-center, namely, slightly to the right of the actual or geometrical centerline of the flat strip width. You will observe that the number of bends on either side of this line is the same, namely three. Also that the amount of work to be done by the rolls on either side is about the same. For while the top bend on the left virtually requires doubling the metal back on itself, the radius of the bend is fairly easy, involving about the same amount of work as each of the other four bends to the left and right of the vertical pass line. These, as will be seen, form angles of only about 90 deg. but are made sharper, that is with smaller inside radii.

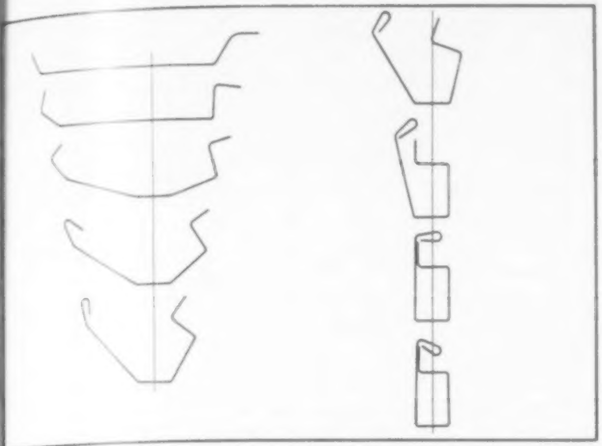


Fig. 6. As can be seen by the progression of passes on this window screen, work design should allow equal stress on both sides of a theoretical centerline of the flat strip.

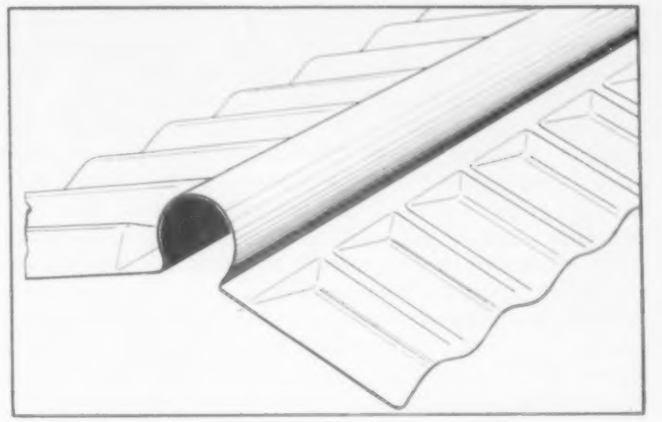


Fig. 7. Above is a corrugated ridge roll section which, formerly made on a power press, is now produced from coiled stock on a roll forming machine at considerably lower cost.

As to the number of roll passes required, there are definite limitations to the amount of forming that can be done in any single roll pass, and these limitations must be kept in mind as well as other rules governing sequence, etc., in making the flower.

In respect to sequence, the forming must as already mentioned usually start at the center, or as near to it as the profile permits, proceeding in successive roll passes towards the edges. The reason is that many bends or beads if first formed at or near the edges, would lock the metal in place between the rolls, causing it to tear if subsequent forming is to be done nearer the middle. Such forming obviously cannot be done without pulling the stock from both edges towards the middle. Therefore, once the metal is locked between the rolls by the forming of angles or beads near the outside edges, any subsequent attempt at bending nearer the center will necessarily result either in stretching or tearing the metal.

If, however, the forming near the edges is of such a character that it does not prevent the stock, confined in the roll passes, from being pulled in toward the center in subsequent passes, exceptions may be made to this rule. Fig. 7 shows a corrugated ridge roll section, heretofore usually made in power presses. Recently, however, it occurred to one manufacturer that this shape could readily be continuously made in a roll forming machine from coiled stock, at a big gain in speed and correspondingly reduced cost. In addition, any desired length can be produced without change of tooling simply by adjusting the automatic cut-off. In making this shape in a roll forming machine, the transverse corrugations on both sides are formed in the first roll pass. These corrugations, because running transversely of the shape, do not resist the subsequent inward pull to form the central ridge sufficiently to cause objectionable stretching or tearing.

As to limitations to the amount of forming that can be done in any roll pass, a basic rule is that under no circumstances should a bend be great enough to "carry back" through the strip into and beyond the preceding roll pass. To understand what is meant by this, and by the words carry back, bear in mind that the flat strip is progressively being made a little narrower by being bent in towards the vertical pass line. For example, when forming a channel, say one inch wide, the shape tapers from the full strip width at the entry end which may be, say, three inches wide, to a final width of only one inch at the exit end. Fig. 8 is a visualization of the "carry back" of the bending stresses set up between the second and third roll pass in forming two channels, one with narrow and the other with deep flanges, but of the same finished width.

This drawing indicates the right edge line of a strip to be converted to a relatively shallow channel and also a deeper channel, the being being along the line *B-B*. Because the metal is bent to a sharper angle in the second pass, and the edge held tightly along the tapering edge line, a line of stress will be set up diagonally between the bend line in the third pass and the edge of the strip near the first roll pass. In the shallow channel, this stress line is shown to intersect the edge of the strip close to the first pass, but still not *in*, or extending back beyond, this pass.

In the deeper channel, say one having wider flanges as indicated above, but otherwise the same thickness and ultimate width, the stress line would be about the same, but with the big difference that is this case the diagonal stress from the third roll pass backwards to the edge would extend to a point somewhere back of the first roll pass. This would cause an excessive stress at the outer edges of the strip as it comes out of the second roll pass, causing the edges to be stretched in passing through. The greater length of the metal here would cause the finished shape to have wrinkled or wavy edges.

To prevent this from happening, the channel with the wider flanges would have to be formed less abruptly; that is in more roll passes than one with narrower flanges. When using heavier gages—0.090 in. and heavier—the carry-back of the diagonal stress line will be even longer than just indicated, hence the amount of forming between the roll passes must be still further reduced in order to prevent stretching of the edges. This, as just mentioned, increases the number of roll passes required.

In other words, the angle or length of the "carry-back" depends on thickness as well as width of leg to be formed, and also on the kind of stock used. All three factors must be considered in their relation to the spacing between the roll stands. As no exact mathematical formula exists for working out the answers, the roll designer must lean heavily on past experience in comparable cases. Where the section is fairly complex it is also important that the roll designer be free from bias and pressure from outside sources.

Over-Forming

More severe bends can normally be made in the initial stages than in the final stages of roll forming for the final passes must bring the shape to its exact and final profile and insure against "spring-back". In fact, with springy stock, slight over-forming may be necessary.

All passes must be so designed that their surfaces are in contact with the largest possible area of the stock being formed, and so balanced between the left and right sides of the centerline as to insure good traction and freedom from side pull.

Theoretically, the pitch diameters of the rolls are the same for all the passes, but as the strip elongates slightly and to a varying degree in passing through the rolls, the pitch diameters are progressively stepped up to a slight extent so as to maintain a satisfactory and uniform tension on the strip for traction purposes. This may be important because if the traction should decrease between any two passes, the one pass would be pushing the strip forward faster than the next pass would be pulling it in, often resulting in buckling of the stock and interruptions of the operation for cutting off and removal of the buckled strip.

To aid in pulling *in* the edges of the strip in entering successive roll passes, and especially in the initial two or more passes, where most of the forming is being done, flanges must be provided on the female rolls. The dimensions and profiles of these flanges should be sufficient to prevent scoring of the outside surfaces of the stock as it is being forced in the downward in the lower or female rolls (Fig. 9.)

From this line drawing which illustrates the change in profile of a channel between the second and third pass, the outside surfaces on both sides would be scored in being pulled in against the edges of the lower rolls in the third pass unless these rolls were provided with flanges as shown to prevent this from happening. These flanges are also designed to prevent excessive wear of the edges of both the upper and lower rolls.

Due to interference from idler rolls and for other reasons, it is not always possible to use flanges of the desired depth. When this is the case, it is necessary to give the inside edges of the flanges a very generous radius as shown at *H* in Fig. 9. A generous radius here is always recommended, regardless of the size of the flanges.

After the successive profiles have been roughly drawn with due allowances for the various limitations described, the dimensions and angles are accurately calculated from the finished shape in order to establish the exact strip width, as shown in Fig. 10, again using the window screen section as an example.

For the purpose of machining and grinding the rolls and spacers, a detail drawing of each roll pass is made, indicating degrees and radii of angles and dimensions of flat areas between them, horizontal distances between bends, and other data, including dimensions of spacers. Fig. 11 represents the fourth roll pass of the same window screen section. From right to left, this tooling is, as will be seen divided into three main parts, numbers T1, T2 and T3 for the top and B1, B2 and B3 for the bottom tooling. T2 and B2 indicate the rolls in the middle, and the right and left sections are, of course, the spacers.

After all the passes are calculated and laid out as shown, the rolls can be machined on conventional toolroom lathes, heat treated and ground in a roll grinding machine with radius-turning attachments.

The method just described was developed some years ago by a manufacturer as a more accurate and satisfactory method of designing, machining and grinding the profiles than the old template method, being especially necessary in making the first and original set of rolls usually ordered with a new roll forming machine, for the production of more or less complex shapes.

Dependence only on a set of templates may be satisfactory for the simpler shapes, especially when merely duplicating a set of wornout rolls. But the template or hand method is inherently incompatible with the high degree of accuracy desirable for high production to close tolerances. It is often difficult to make the templates fit the samples and the rolls fit the templates with the desired degree of accuracy.

With the old method, more time often has to be spent in fitting the rolls to each other before the correct shape in forming can be continuously obtained, with a minimum of interruptions, spoilage and rejects. The new method greatly reduces dependence on the workman's skill and experience. It places roll making on a more accurate, scientific basis, less dependent on the old fit-and-try method.

In machining the rolls by the new method no templates are, as already mentioned, necessary. An allowance of about 0.005 in. is made for subsequent grinding.

In checking the fit between upper and lower rolls, a feeler gage, made from a narrow strip of the stock to be used, is inserted between them. The clearances in the bends and curves should be slightly smaller so as to increase the pressure in these areas of the profile. The clearance here should be from 0.0005 to 0.001 in. smaller than the stock thickness.

Training Operators

In the course of years, the design of roll forming machines has been greatly simplified and standardized with a view to facilitating operation, tool changes and adjustments. Vital parts have been made easily accessible, easily adjusted antifriction bearings, micrometer gages, and devices for precision control and automatic operation, have been adopted.

As a result, in a few weeks any intelligent mechanic can acquire the basic knowledge required for operation, adjustments, tool changes and maintenance. Speed and accuracy are quickly acquired, so that within a few months, production per day and quality will be at or near the maximum obtainable.

Time required for roll changes varies according to the number of passes and the complexity of the profiles. Average time required for changing tooling light enough to be easily lifted by one man, on a machine of eight to ten roll passes, will be from one to two hours for the simpler profiles, and from three to six hours for more complex ones.

Some manufacturers furnish an instructor for training a new operator in making tool changes, testing and adjusting the setups and operating a new machine. Where the services of an instructor are necessary or desirable, it becomes an added consideration in the purchasing of a new machine.

Materials for Roll Manufacture

If relatively small quantities are to be produced of any given shape, and the profile is simple, without sharp edges

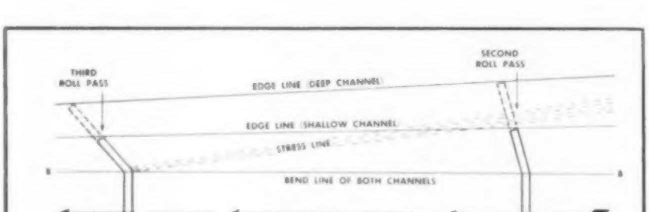


Fig. 8 is a visualization of the carry back of bending stresses set up between second and third roll passes in forming two channels, one with narrow and the other with deep flanges. Both have the same finished width.

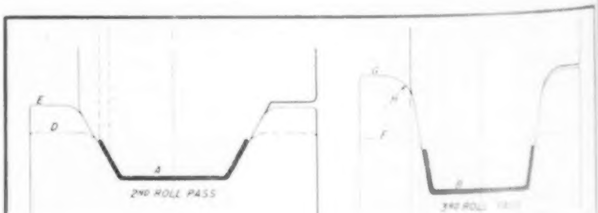


Fig. 9. Flanges provided on the female rolls aid in pulling in the edges of the strip in successive roll passes.

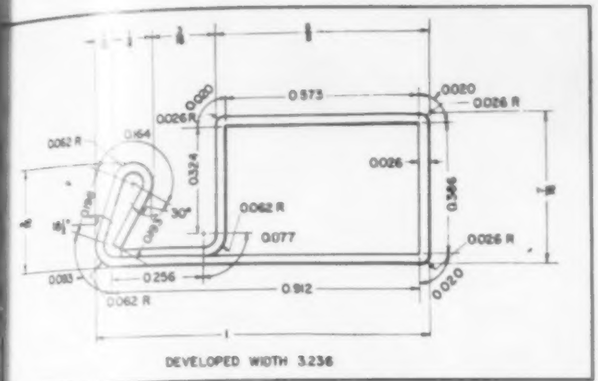


Fig. 10. Final dimensions and angles are determined from the finished shape, after profiles have been drawn, to establish the exact strip width.

and delicate contours, the rolls may be made of inexpensive machinery steel or semi-steel, and hardening eliminated. Such rolls may produce anywhere from a few thousand up to several million feet, depending on shape and finish of the section, and the material from which it is made.

For the longer roll life desirable in large scale production, hardened tool steel must have good machining quality, must harden to 60-63 Rockwell C, with a minimum of warping, and be capable of being ground and polished to a smooth surface. Using tool steel rolls on aluminum or brass stock, from four to five million feet are frequently obtained before regrinding is necessary.

When shapes are to be formed from hot rolled, unpickled steel, the rolls should be of high-carbon, high-chrome steel, so as to resist the abrasive action of the scaly surface of this stock.

Wide rolls are often made in sections, to the end that different parts thereof may be made of different materials, according to service requirements.

For some parts of the profile an especially tough grade of metal may be chosen, while for others materials may be chosen for hardness or wear, or both. This split roll design also makes it possible to replace worn sections separately.

Split rolls are especially desirable for forming wide sheets in which flat areas predominate, such as V-crimp and similar roof sheets and siding; the flat part of the rolls which do no forming may then be of soft steel, while hardened tool steel is used for those parts which do the forming.

In certain cases it is advantageous to chrome-plate the rolls. This is generally done to minimize scratches and pressure marks on soft or pre-coated stock. However, high-carbon, high-chrome is recommended rather than chrome-plating, to avoid the necessity for re-plating every time the rolls require regrinding.

When hard-surface stock is used, or when the stock has an affinity for the rolls which may result in damage to the finish, bronze rolls are sometimes used to minimize the "pick-up". The life of bronze rolls depends on the stock used.

When forming unpickled, scaly material, an extremely hard metal is required, while for forming cold rolled or stainless steel, aluminum or its alloys, it is advisable to use hard bronze or an alloy, such as No. 20 Ampco.

In order to prevent the guides from picking up surface particles, it is often advisable, especially in forming very soft metal, also to have the hardened and polished guides chrome plated. Similar consideration govern the choice of materials for straightener, idler rolls, etc.

Cost and Life of Roll Forming Machines and Tooling

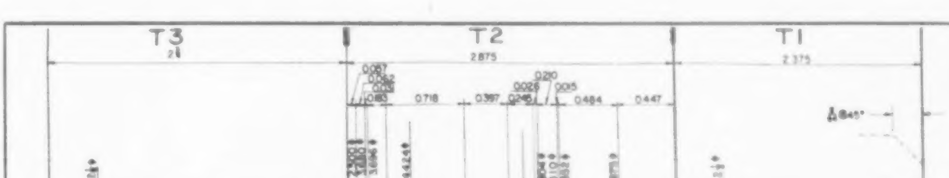
The initial cost of a standardized cold roll forming machine, with a coil box or reel for feeding the machine, and an automatic flying cut-off, motor and controls, ranges from about $10,000 minimum up to $50,000 or more, depending on size and the number of roll stands required. The median would probably lie somewhere around $25,000, not including tooling and die cost. A few typical examples may be of interest. A small inboard machine with five roll passes, coil box and automatic cut-off motor and controls, for producing a venetian blind cornice cost $8,000. The complete tooling for this machine, including cut-off die, cost $1,690. For forming the bottom rail of these blinds (Fig. 12), the same basic size machine was used but 12 roll stands were needed instead of only five, with the cost going to $12,500. The tooling and die cost for this section was about $5,000.

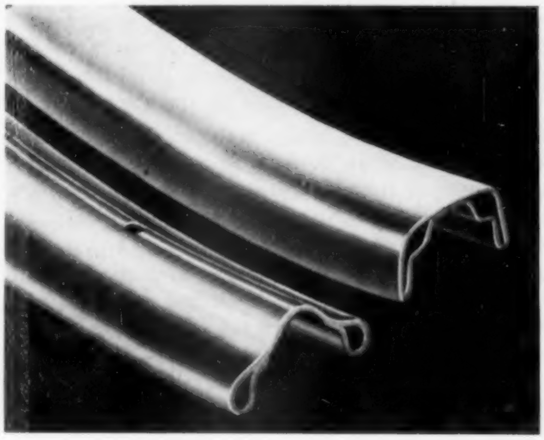
For forming bicycle rim moldings (Fig. 13) a still larger standard machine size was needed, with 10 roll stands. This molding was passed through two electric welders arranged in tandem, to give to the twin tubular shape increased stiffness and strength without increase in weight. The last unit in this line is a special coiling machine combined with an automatic cut-off. These machines were both adjustable so the rims ranging from 20 to 26 in. in diameter may be obtained within a circumferential tolerance of 1/16 in.

This entire production line, including the welders, tooling, die, motor accessories, cost about $37,500.

As to life of machines, there is practically no limit, and maintenance including replacements is small or negligible even in a very old machine, so long as it is not being abused. The obsolescence factor during the past one or two decades has also been very small. Although machines have been constantly improved in accuracy, accessibility, ease of adjustment, and wearing qualities, basically they have not been changed.

Fig. 11. Again referring to the window screen shown in Fig. 6, the drawing at right represents the fourth roll pass. For accurate production of rolls, detailed drawings such as this are made for each roll pass.





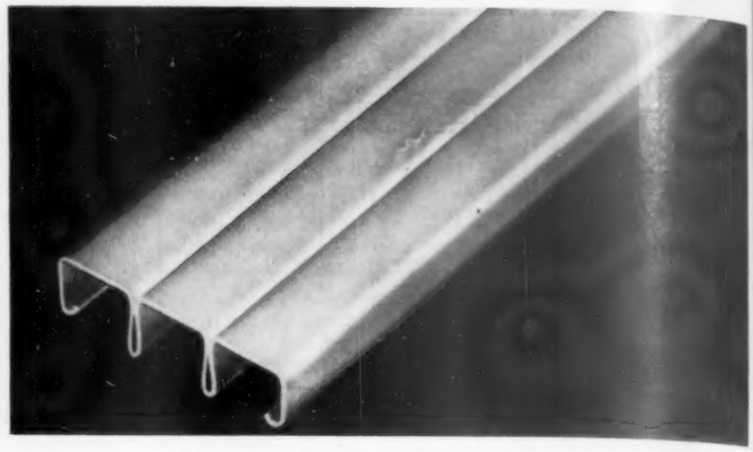


Fig. 12 (left). These venetian blind rails were produced in twelve roll passes on a small roll forming machine. Total cost of equipment and tooling ran $17,500. A larger standard machine was required for the bicycle moldings in Fig. 13 (right).

Wear and replacements of rolls and dies are the principal items of expense. In the majority of applications, three or four million feet can be produced before regrinding is necessary, and several regrindings can be made before ultimate replacement. Keeping the rolls clean greatly prolongs their life.

Speed and Economy

Standard roll forming machines are usually equipped for a constant speed of 100 feet per minute, but may be designed for a higher or lower speed to meet special requirements.

Allowing for avoidable and unavoidable delays during working hours, the daily production at this speed will average about 30,000 lineal feet. This may, but seldom is, stepped up by end-to-end welding of successive coils to avoid the slight loss of time incident to the starting of each new coil through the machine. Many machines are operated only a few days per month, yet are highly profitable.

Generally speaking, if cold roll forming can be used in shaping any product, the conversion cost will be lower than obtainable with any other method. Not only that, but of even greater importance is the reduction in weight frequently obtainable by taking a flat strip of metal and forming it into box, channel, tubular and other hollow shapes to obtain the highest strength-weight ratio. This is particularly true as compared with solid steel and non-ferrous shapes produced in rolling mills, foundries, forge shops and by the extrusion and other methods. Many parts initially made by any of these methods therefore sooner or later are redesigned for cold roll forming, often with the result that both material cost and conversion cost are cut in half or better.

Where to Use Cold Roll Forming

Inherently, cold roll forming is applicable mainly in the mass production of shapes of uniform profile. A limited amount of transverse forming may be done, but the width must be uniform, unless blanks are first cut and fed into the machine.

The minimum practical radius of bends is equal to the thickness of the stock but it should preferably be double the stock thickness or better. With some sacrifice of strength, sharp inside and outside corners are, however, obtainable. In forming wide shapes from thin stock, some bending at or near the outside edges is necessary to stiffen them and avoid waviness.

Conversely, maximum thickness of stock suitable for forming depends on the material used and on the angle or radius of bends or curves. As mentioned, plain angles, channels and other structurals up to ½ in. thick have been and are being produced, and also pipe up to ¾ in. wall thickness.

As a general rule, it may safely be assumed that if a product can be roll formed as is, or redesigned to make it suitable for roll forming, this method will result in reduced unit cost, either because of saving in weight and raw material alone, or in conversion cost or both. A roll forming machine will also provide a much greater production per hour than machine available.

Where the material cost is high in relation to conversion cost, the saving in the unit cost of finished shapes is likely to be the more important of the two factors. This being the case, the first and most important, if not the most difficult task, of tooling and production men generally is to find or discover the places where roll forming is practical. This is a relatively much simpler task when production of a new product is to be started. At this time, however, quantity requirements are likely to be either so small and uncertain, and the initial investment in equipment relatively so high, that it is often decided to use mill shapes, or have the shape cast, stamped, extruded, or made by any other method involving the lowest possible initial investment in molds, dies and other tooling. If power presses already are available in the plant, and only the initial die cost has to be considered, this method is often chosen as a matter of course.

Often it is also erroneously assumed without prior investigation that roll forming for some reason or other is not suitable. The reason may be thought to be that the shape has to be curved, pointed, or otherwise shaped into an ornamental or functional pattern, or the section perforated, notched, embossed, indented or welded. Any or all of these functions can, under most conditions, easily be performed in a roll forming machine or in synchronized attachments or auxiliaries.

Until very recently in a certain large shop, one might have seen in operation three power presses forming plain angles with specially designed ends. It was suggested that one small roll forming machine placed in line with a press for punching out the blanks, would do the work. The suggestion was acted on, and now these two machines, attended by only one girl, are producing considerably more and better angles than were formerly obtained from three operators and three presses.

The case is typical of conditions found in many shops: The method first chosen may have been the best compromise under the circumstances then existing, but increased quantity requirements sooner or later made it too expensive.

In another case, a large company installed three roll forming machines at one time, to produce sections formerly made by the extrusion method. In this case, the old method was continued by default until quantity requirements had become from six to twelve times greater than sufficient to have made one single roll forming machine a profitable investment.

Tooling Up For Modern Truck Engine Production

By Joseph Olender
MECHANICAL ENGINEER
TRUCK ENGINE WORKS
INTERNATIONAL HARVESTER COMPANY

THE RECENT ANNOUNCEMENT of International Harvester's new line of trucks climaxed a tooling program representing an investment of more than $30,000,000.

Emphasis on sturdy and accurate machine and fixture construction was the program keynote. Coupled with advanced product engineering, sufficient overload safety factors were stressed for long range quality in the product. Three basic models of "L" line truck engines are produced at the Company's Indianapolis plant. They are the valve-in-head Silver Diamond with 220 and 240 cu in. displacement, the Super Blue Diamond with 269 cu in. displacement, and the Super Red Diamond with 372, 406 and 450 cu in. displacement.

Synchronized Planning

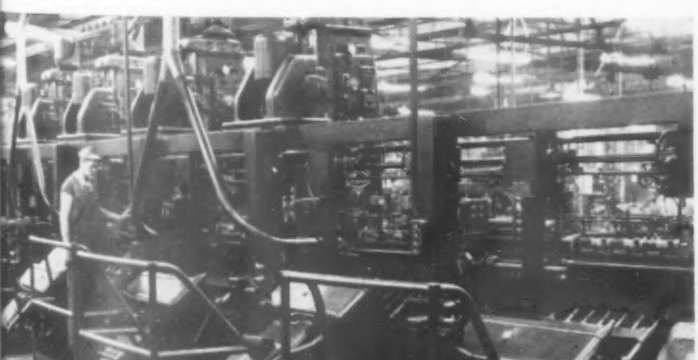
Planning, research and preparation for production of the new "L" line, while coordinating the transfer of our "Green Diamond" engine line to Harvester's Springfield, Ohio Works, required more than a year of continued effort.

Plant layout stressed minimum material handling. Machining lines were laid out to spur into the main assembly building at a point approximately where the manufactured parts are sub-assembled or assembled to the engine.

Purchased items are located conveniently between the engine assembly lines at approximately the points where the parts are used. Effects of the combined material flow reduce trucking and material handling which results in a substantial saving.

Selecting the equipment necessary to give maximum manufacturing efficiency required careful planning.

The original plan for retooling the plant had as its first objective the comparison of two manufacturing plans: (1) A manufacturing plan using conventional equipment only; (2) A manufacturing plan calling for the use of high production, transfer and single-purpose machinery and equip-



The above three-quarter view of this fifteen-station Natco engine cylinder head processing machine shows the angular heads for sprak plug machining operations as well as vacuum ship ducts that remove excess shavings as the parts transfer from station to station.

Cylinder bores are rough bored on the first unit, chamfered both sides on second, bearing bridges are straddle-milled and lock slots are machined on third, and mill pads are milled on fourth unit of this 10-station machine.

ment wherever it could be used to advantage over conventional equipment. Plan 2 was superior to plan 1 because it permitted us to realize our manufacturing goals with less floor space, more production, and less overall capital investment.

Virtually every piece of equipment in the engine plant was relocated, with the exception of the Blue and Red Diamond heavy duty crankcase machine lines and the block test. At the same time, several building extensions were added to house a new engine assembly building, metallurgical laboratory and cafeteria kitchen.

Tool Care Considered

Much thought was given to tool care problems while the program was progressing through its planning stage. It is common knowledge that down-time is the worst production enemy on any transfer or automatic cycle type machine. Great strides were made in eliminating down-time by designing equipment with quick-change and pre-set tooling facilities.

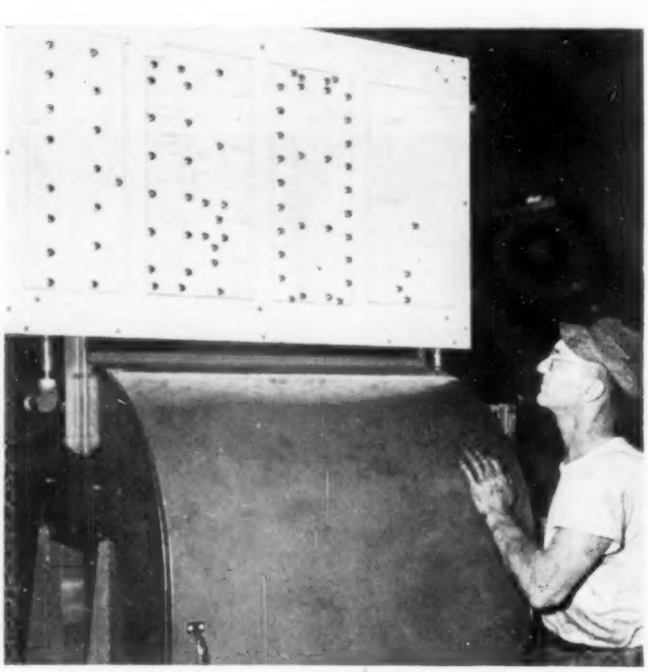
All transfer machines have tool racks filled with pre-set tools and gage holders in convenient locations. Quickly removable guide rails and cutter set pads which employ the use of magnetic set gages in easy-to-reach locations are installed on the milling machines.

Such features enable the production department to make a complete change of cutting tools in less than 45 minutes on most of the large transfer machines.

Transfer and Special Machines

In order to meet the production demands on the Silver Diamond machining lines, transfer equipment was selected for the cylinder block and cylinder head and the "cast-in-block" main bearing caps.

The Silver Diamond cylinder block transfer equipment consists of Ingersoll milling machines for all milling and cam and crank boring operations. Footburt transfer machines complete the balance of drilling, reaming, chamfering and other operations.



Above is an automatic hole checker on the block line. Red lights on panel board above checking machine indicate improper drilling, assuring that all holes are to the correct depth prior to tapping.

This 11-station transfer milling machine performs the following operations on the cylinder block: rough and semi-finish cylinder head gasket surface and rough and finish pan rail; rough and finish mill and broach bearing locks and seat; drill, ream reference holes used to locate block on succeeding operations.

A special open-type Sundstrand transfer mill on the cylinder-head line completes all milling operations with the exception of the combustion chambers which are precision-milled on a pair of Cincinnati profilers. Natco transfer machines are used for all of the drilling, reaming and valve seating operations on the Silver Diamond cylinder-head line. These operations are cycled at 60 seconds. Most of the milling which is performed on alloyed cast iron (approximately 220 Bhn) is run between 45 and 60 ipm feed.

The water pump bodies are fully machined on a special Cross index table-type machine which completes a rough foundry casting into a finished part at the approximate rate of 50 pieces per hour.

Oil pumps likewise are machined on a compact drum-type Cross machine with the only other remaining operation being precision boring gear pocket and shaft holes. These are machined at a rate of 60 pieces per hour.

Timing gear teeth are cut on 6-station vertical hobbing machines with 3 and 4-start hobs which hold to closer accuracy than was obtained formerly on single spindle hobbing machines with single thread hobs.

Gisholt Dynetric balancers automatically find and record the crankshaft unbalance which is corrected in the second station.

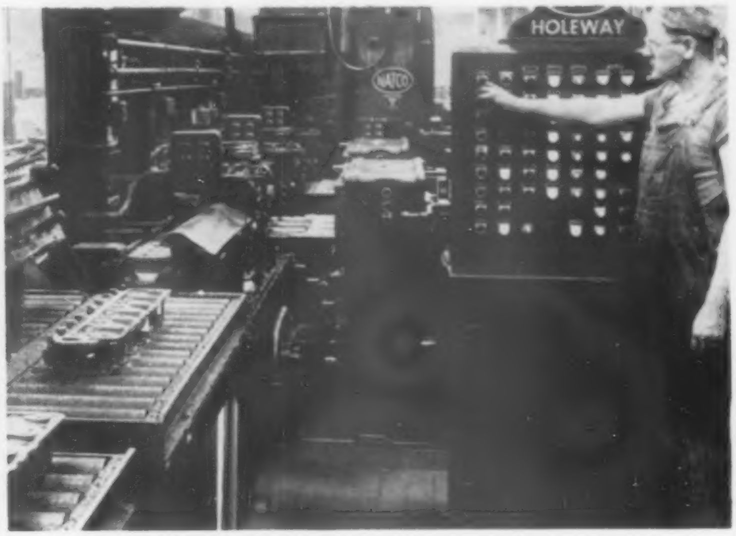
Multiple-wheel "IW" Landis grinders finish-grind simultaneously five diameters on the crankshaft to plus or minus 0.0003 in. tolerance. Similar machines are used on the camshaft lines.

Valve guide bushings are pressed in and pull-broached to an 0.001 in. tolerance in automatic-cycle special Oilgear broaching machines, both vertical and horizontal. Tool life has been increased over 500 percent and the quality has been increased greatly.

Electronics in Safety

All transfer, semi- and fully-automatic cycle machines are equipped with electrical interlocks coupled with mechanical "safeties", assuring proper location and clamping of parts being processed. Each part must be secured in proper location before the machine cycle starts. Panel lights at the

Seven-station open-type transfer mill on cylinder head line which completes all milling operations with the exception of combustion chambers, which are precision milled on a pair of Cincinnati profilers.



At right is a 15-station transfer machine, which performs all drilling, reaming, spotfacing, finish valve seating operations and tapping on the Silver Diamond cylinder head.

operator's, or loading, station indicate whether work stations are cycling correctly.

Some machines which are hand loaded, have a limit switch control for the wrench. Machines will not cycle until the operator is clear of the machine, thus avoiding possible accidents.

Quality Control, Sample Inspection

Inspection and quality control departments played an important role in selecting gaging equipment for better finishes and closer tolerances.

Vital operations are covered by machine control charts. A constant vigil is kept by the line inspectors and the machine operators to see that the piece parts conform to statistical quality control standards.

Critical dimensions are held to approximately 50 percent of the normal or specified engineering print tolerances. Certain quantities of sample parts are selected at random, depending on the lot size ready for inspection. Every part in the sample group must check 100 percent to the quality control specifications or the entire lot of parts is rejected.

The use of direct-reading inspection equipment is essential in the development of such a program.

Part Banks

Floor space has been provided between each transfer unit in the cylinder block and head machining lines for building up banks of progressively machines castings. Overhead cranes move these castings to and from the banks, which assures continuity of line production during tool changes.

Banks are used on many other parts and lines where maintaining an even material flow for continuous-shift operation is essential.

Pre-Production Time Study

Analytical pre-production time studies of this new tooling was tried in this program and has proven very satisfactory. This was accomplished by having the job in operation before placing the production manpower on the equipment for production. Some of the benefits derived from the program have been the elimination of most of the "first production bugs", systematic channeling of changes, better knowledge of "job know-how" by the supervisor, elimination of the usual confusion in instructing operators on the many operations included in a tooling program of this magnitude, reduction of safety hazards, and the establishing of a more accurate time standard along with quality.

Housekeeping and Chip Disposal

In order to maintain good plant-wide housekeeping we have inaugurated a weekly competitive employe safety and housekeeping program. Each week the winning departments display the "Honor Flag", and a suitable award is presented to the final winner at the close of the year.

Under-floor chip conveyors are installed in production departments using transfer type equipment. These chips and borings are conveyed to a junction point in the machine lines, where they are picked up automatically by an elevator and discharged into a stationary gondola.

Care is exercised to maintain chips and borings free from oil, water and other wastes before being transferred to the foundry briquetting machine.

Pattern and Fixture Storage

Patterns and fixtures are taken to a central pattern storage in the foundry and a fixture storage in the machine shop where they are repaired and checked to blueprint. Then they are put into storage for future use. This systematic repair work which is done as fill-in work in the pattern shop and tool room has resulted in a saving of $40,000 per year.

Receiving Purchased Material

Most of the purchased parts are delivered to the receiving dock by truck. Here most parts are palletized, if not already so prepared, and transported by finger lift-trucks to the receiving floor. Samples are then taken for quality control check and quantities are verified by counting or weighing. As soon as it is approved for quality, the material is routed by finger lift-truck to various storage areas adjacent to the point of usage. The time limit set for the receiving, checking and releasing process is 48 hours. No productive material store room in the common usage of the term is maintained.

Automation in Forging and Heat-Treating

By Thomas E. Darnton and Willard L. Mantz
SUPERVISOR OF STANDARDS SUPERVISOR OF PRODUCTION ENGINEERING
FORGE PLANT OLDSMOBILE DIVISION
GENERAL MOTORS CORPORATION

Automation in the handling of steel forgings is a highly important phase of our operations at the Oldsmobile forge plant. In order to successfully handle over one million pounds of forgings that are shipped from our plant each day it is vital that the individual movements of this material through the various forging operations is both well organized and makes use of the most modern type of materials handling equipment.

Steel bars are received via both railroad car and trailer trucks, in bundles equalling approximately five tons in weight and ranging from ten to fifteen feet in length. The bundles are unloaded by a magnetic crane and stored in our outside steel yard. It is our practice to carry approximately thirty to forty-five days' requirements of bar steel all of which is stored separately by heats and marked accordingly with paint. In most forging parts it is necessary to keep the heats intact and run the entire heat as a unit, so this storage is important in the separation problem.

When the steel is ready for processing it is moved by the magnetic crane to power conveyors which project into the steel yard. The bundles move inside the buildings are broken, then rolled onto a gas-fired pre-heat table. From this point the steel moves directly through billet shears by a power-driven conveyor where it is cut to proper length.

Steel bars, after being cut to length, are placed in either a container or a rack in units of approximately 5,000 to 6,000 pounds. Fig. 1 shows a rack of billets for crankshafts being transported from the shearing operation into storage by a three-ton finger truck. The Oldsmobile forge plant has a fleet of thirty-five of these fork-type industrial trucks. We have found them to be very reliable and durable in their assignment of moving the many thousands of pounds of steel forgings through the production departments.

The crank billets, after shearing, are moved from storage to a position in front of the pusher furnace in which they are heated for forging. The crankshaft billet heating furnaces are capable of heating at a rate of eighty cranks per hour (150 lb each).

Fig. 2 shows the operator unloading a crankshaft billet from the furnace; this is done with a twelve-foot pair of tongs counter-balanced on an overhead monorail. The operator moves the heated billet (2300 deg F) to the first hammer operation by pushing it along the monorail which guides it directly to the hammer. The handling of the crankshaft through the forging operation is similar to that illustrated in Fig. 2. By successive operations it is moved via tongs and monorail and finally placed on a rack at the finish of the last forging operation. The racks of finished forgings are now ready for the heat treat operation, and are transported from the forging department to the heat treat department by means of industrial three-ton fork trucks. The rack of fifty crankshafts is placed at the charge end of the heat treat furnace by the truck, then loaded on the furnace table with a small air hoist (Fig. 3). The cranks

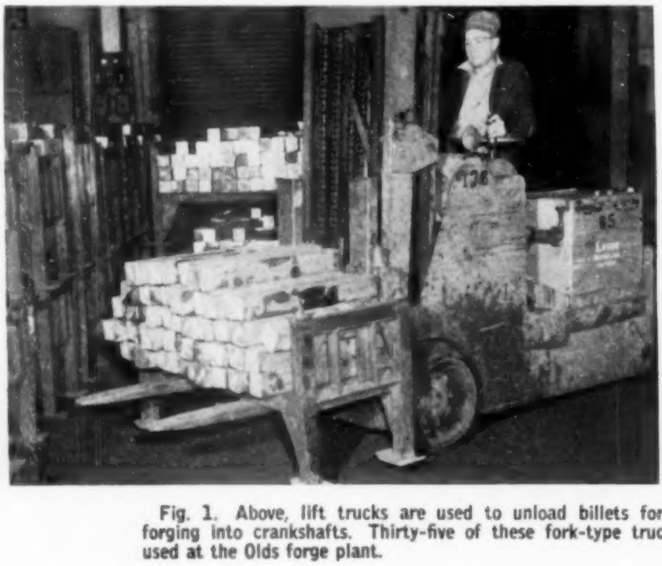


Fig. 1. Above, lift trucks are used to unload billets for later forging into crankshafts. Thirty-five of these fork-type trucks are used at the Olds forge plant.

Fig. 2. An overhead monorail supplies the counterbalance for the twelve-foot tongs this operator is using to manipulate a heated billet into the forging hammer.

st on alloy shoes which are guided through the furnace tracks.

The crankshaft furnace is one of three completely automatic units capable of handling and heat treating one hundred crankshafts per hour each. The furnaces are operated with no manpower touching the crankshafts from the time they are placed on the charge table until they come out the draw furnace.

Fig. 4 illustrates four crankshafts resting on the quench arm which lifts them from the alloy shoes and then lowers them into the water directly below. The furnace is operated by limit switch control actuated by timers set for approximately 2.4 minutes per push. After proper quenching time has elapsed the automatic quenching arm redeposits the crankshafts on the alloy shoes on which they are then pushed into the draw furnace.

After the crankshafts leave the draw furnace they are handled manually by tongs suspended from a monorail onto the table of a straightening press. Here they are checked and straightened to 1/16 in., then placed on a monorail conveyor as shown in Fig. 5. This conveyor is approximately 1,500 feet in length, and carries the crankshafts suspended from the flange on an acid-resisting alloy hanger. The conveyor passes through a water cooling tank to bring the forgings to approximately room temperature. This tank also removes a large portion of the loose scale. The conveyor then makes three passes through a 75 ft pickle tank containing a 12 percent solution of sulphuric acid at 170 deg F. All scale is removed from the forgings in this pickling operation, and it is performed automatically without any man-power assisting.

After the crankshafts come out of the pickle tank, they pass through a spray rinse and neutralizing wash. The conveyor carries them to the final finishing department where the crankshafts are removed from the overhead conveyor and placed on the finishing slat conveyor as shown in Fig. 6. This power-driven slat conveyor is 80 ft in length and 4 ft in width. As the crankshaft is transported down the length of the conveyor it is finished prior to shipping to the machine shop. The first operation is to remove it with the assistance of a block and tackle and place the crank in the mass balancing machine. This machine rotates the crankshaft, and the operator, by manipulating the machine, brings the crankshaft into dynamic balance. With the crankshaft in balance the centers are then drilled. The crankshaft is further carried on the conveyor to the final operation where it is checked for proper index and marked with starting points for machining.

The production of more than two hundred different forgings necessitates the use of considerable ingenuity in the planning and design of material handling equipment and methods. In a plant such as the Oldsmobile forge plant conventional equipment is usually inadequate due to the weights involved and the extreme high temperatures of the materials during the processing operation. For this reason it is necessary to have trained personnel carefully scrutinize and supplement the designs of handling equipment.

Fig. 3. A small air hoist is employed here to load crankshafts on the furnace table for heat treating.

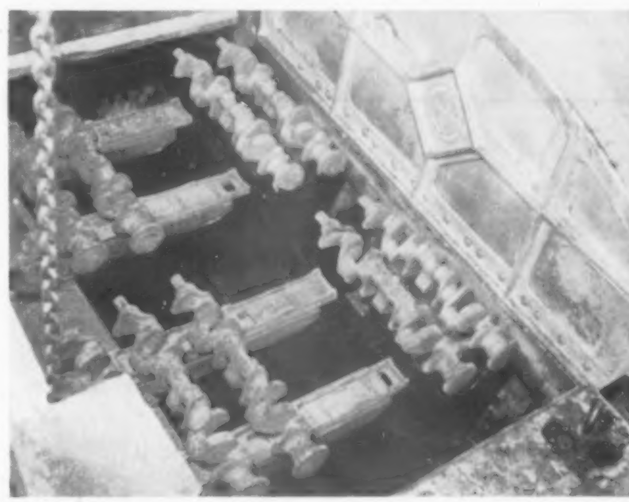


Fig. 4. Four of the crankshafts above are resting on a quench arm which lifts them from the alloy shoes and then lowers them into the water directly below for quenching.

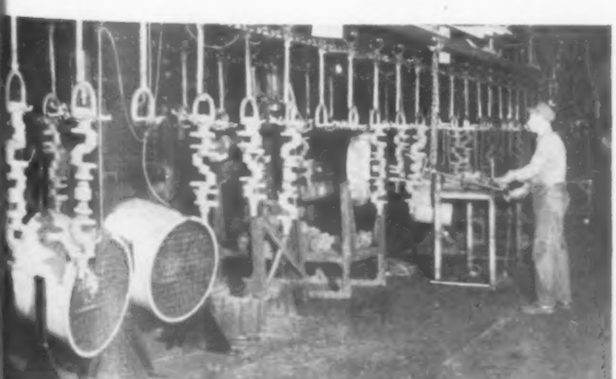


Fig. 5. This 1500-ft monorail conveyor carries the crankshafts on alloy hangers from the draw furnace through a water cooling tank to bring the crankshafts to room temperature.

Fig. 6. Final finishing of the crankshaft prior to shipping takes place on this 80-ft power-driven conveyor. The crankshaft is balanced, drilled and checked for proper index for machining.

Automation of Turned and Ground Parts

By N. C. Bean

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AUTOMATIC TRANSMISSION PROGRAM
FORD MOTOR COMPANY

Automation might be described as the art of automatically handling a product to or from a machine or assembly operation without physical effort.

Ford has gone a long way in applying automation, especially where it has taken the fatiguing labor from a tiring job, or where it has either lessened physical labor, or eliminated it altogether, allowing workmen to be placed on more needed production operations.

As an example, removing stamping trimmings from a press is an ideal application for automation. When this job is done manually, it is a constant source of injury to a workman's hands as well as being tedious and expensive. With little cost and effort, trim stock from a press operation can be sent to a scrap bin or container without adding direct labor to a production job.

When plans were first considered for an automation program, jobs were selected where several parts were required per car. Pistons, valves, push rods, valve guide bushings, and similar parts were considered for the machine shop "guinea pigs."

We selected the valve guide bushings, because at this time the bushings were made as a split unit consisting of two identical halves. Thirty-two of these halves were required for each V-8 engine.

A few weeks later our product engineers decided to eliminate the two piece bushing and make it solid; however, it would be identical to the two halves of the former design.

The cast iron bushing is heat-treated to give a Brinell hardness of 141-179. It is about 2¼ in. long; about 3/5 of the length is about 1 in. diameter while the balance of the bushing is ⅝ in. diameter. This condition puts the center of gravity of the part well away from the dimensional center line.

High Production Requirements

Our daily production and service requirements are in excess of 100,000 bushings, therefore, the selection of the part worked out very well as an automation project.

When the bushing was produced manually, groups of individuals were required to perform identical operations with such frequency that mental concentration required to repeat identical performances was always difficult. Even with conscientious effort, doing the same thing over and over during an eight-hour period invariably became tiresome and tedious.

A machine, properly designed and constructed will perform identical operations under identical conditions. Obtaining and maintaining this factor is the answer to successful automation.

The first step towards automation of the valve guide bushing is getting the material to the first machine operation in an efficient manner. The bushings are received from the foundry in tote-bins, about 4 ft long, 3½ ft wide, and about 2½ ft high. A telescopic fork truck with a rotating device brings the steel tote-bins from the receiving dock to the department where the bushings are machined.

Using the fork truck, the bin is raised about 9 feet in the air and rotated 180 deg, dumping the contents into a large hopper, shaped like an inverted pyramid. This hopper bin is about 6 ft sq and about 4½ ft high. The sides taper to a converging point near the floor. A cleated continuous belt conveyor carried the bushings up an incline to an agitated hopper which supplies automatically, the parts to the first of three centerless grinders, for semi-finish grinding the outside.

First, second, and third grindings are accomplished automatically. The hopper supplies an even stream, (we will call it that because end to end without a break, it appears like a hose) through the first grinds.

The fiirst grinder removes 0.020 in. of stock from the diameter and uses vitrified-bonded silicon-carbide wheels with a 30 grain P grade abrasive. The wheels are 24 in. diam and 6 in. wide.

Aluminum oxide wheels are used for the second and third grinding passes. The wheels, 20 inches in diameter and 6 inches wide, are made with 46 grain M grade abrasive. The second pass removes 0.013 in. from the diameter and the third grind removes 0.010 in. The regulating wheels are 12 in. in diameter and run at 94 rpm.

There are four identical grinding lines with the large hopper bins and the three grinders. After the third grind

The bushings fall onto a narrow belt conveyor which passes at right angles by each line of grinders. The belt conveyor dumps the bushings onto a chain mesh belt which carries them through a continuous washer. This operation is necessary, because it removes grit and abrasive from the surface of the bushings which would be picked up by collets and chucks of subsequent operations, if not removed.

Another belt conveyor carries the washer parts to a battery of automatic screw machines where turning the small OD, drilling, reaming, and chamfering operations are performed.

Coolant for these operations plays an important part in the control of quality and production. Dirty or contaminated coolant causes excessive wear on mechanized moving parts as it creates sludge and deters free function of chuck jaws and other moving parts. Sanitation adds to the safety and hygiene of the workers who may come in contact with the coolant.

The automatic screw machines employed in these operations have "top-hat" baffles in the base of the machine, which completely surround the drain outlet. These baffles are merely cylinders welded watertight around the drain area and extending up about seven inches, which causes the coolant to settle at the outlet area of the drain. The heavy particles carried into the bottom of the pan quickly settle, while the lighter fluids overflow the "top-hat" baffle and return for recirculation.

The belt conveyor which supplies bushings to the automatic screw machines, drops the parts through bypass gate and down the chutes to a hopper near the floor.

These hoppers, when heavily filled, cause a switch to actuate the bypass gates so that stock continues to another hopper, not yet filled. This type hopper operates entirely different from all others in the department. The bushing castings are automatically and continually pushed up a vertical twisted chute and are then slid into a magazine. Here, they are fed one at a time through the rear of the hollow spindles into collets of the six-spindle automatic machines by cam-actuated loaded plungers.

A stop positions the bushings and a trip lever causes the chuck jaws to clamp firmly. When an angular loading chute becomes filled, surplus parts slide down another chute, back into the loading hopper.

Bushings are drilled, reamed, formed, and faced at a rate of nearly 900 per hour on each of these six-spindle Acme-Gridley automatics.

Actually, these machines produce better than 3,000,000 pieces a month and the only manual operations required are periodic checks on machine set-up and product quality.

The hole through the bushing is 0.323 in. in diameter through the entire length. The holes are progressively drilled in about ⅝ in. steps in five stations, each overlapping the previous. The drills are operated at 130 sfpm with about 0.0075 in. feed per revolution. The drills normally run one complete shift before replacement changes are necessary.

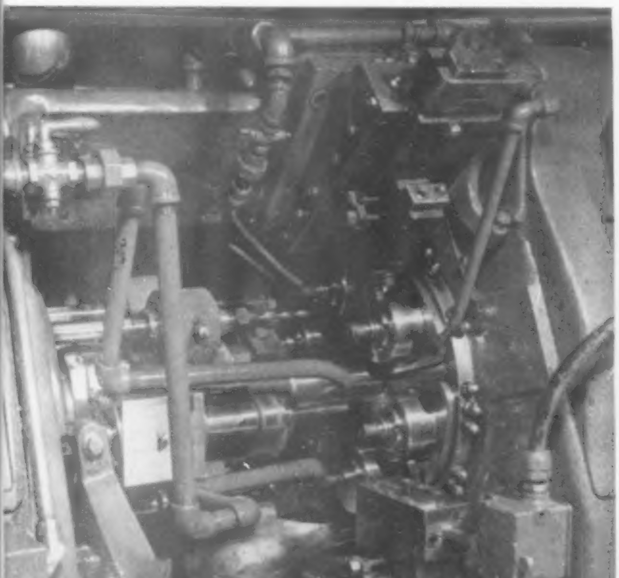
The sixth spindle control reams the hole.

Spindle speeds of 792 rpm provide turning speeds of 213 sfpm for the carbide tools which form, turn, and face the end and diameters.

A light oil coolant is used primarily to flush away chips from chuck jaws and collets. The tolerance between the OD and ID is 0.002 in.

Another improvement change in the bushing, is the addition of a groove turned in the OD into which a neoprene air or oil seal is placed at engine assembly. Inasmuch as only the intake bushings require any type of seal, 50 percent of the production does not have this groove machined.

Therefore, as the bushings are ejected from the automatic turning machines, they fall on a rubberized belt and 50 percent of them travel to the finish OD grinders.



The bushings are shown above in the collet during the drilling, reaming and turning operations. The bushing leaving the machine in the chute (center) indicates that a spindle index has just been completed.

Bushings are pushed in an upward direction in this vertical twisting chute, where they are permitted to roll into a vertical magazine. When the magazine is filled, the overflow falls into a chute and is returned to the original operation.

The other 50 percent are bypassed and continue to the automatically fed and ejected collet lathes. The 50 percent that are finish ground fall from the belt conveyor into a hopper which in turn feeds them automatically through the centerless grinder.

These machines remove about 0.0015 in. from the diameter at a rate of approximately 75 pieces per minute.

Vitrified-bonded aluminum-oxide abrasive wheels 20 in. in diameter and six in. wide with 60 grain, M grade and 5 structure are used.

Close limits of plus or minus 0.00025 in. on the diameter with approximately 8 rms. finish is maintained with practically no rejects.

The 50 percent production that are used in the exhaust valve holes continue on, bypassing the finish grinders and fall into a floor line hopper bin. From this bin an incline conveyor carries them to an elevation near the ceiling (about ten feet in this area). This hopper selects the bushings, not only at the proper rate of speed, but with the large end of the bushing preceding the smaller end. In this position they fall into two magazine chutes which form the ends of a "U" shaped affair which has been nick-named "The Horse-Collar."

The machines are six spindle, one-inch automatics. By coincidence, the spindle center circle is in even multiples of the diameters of the valve bushings so that when the bushings slide down each side of the "Horse-Collar" and the bottom bushing on each side is stopped in position on the centerline of each lower spindle, the bushings higher up the chute space themselves perfectly on the center line of the other spindles.

A cam-fed pusher is cycled to inject a bushing through the back of each spindle into the collets. The forward motion of these bushings push the just-turned bushing out of the collet, down a chute onto another short conveyor and back to the finish centerless grinder, which was just previously bypassed. The exhaust and intake bushings are ground on different grinders but with identical set-ups.

This separation of intake and exhaust bushings continues until shipping. After finish grinding, the bushings fall into wire baskets, which are baffled in such a manner that the falling momentum is checked with a rubber bumper just before falling gently into these baskets.

When the baskets are filled they are placed on a belt conveyor by a quality control or set-up man. They are later automatically shifted from the belt conveyor to a wire mesh conveyor which passes through an automatic washer.

As they emerge from the washer they are picked up by a monorail conveyor which transports them to the boring machines.

The boring machines offer an excellent study of high production application. The battery of seven Ex-Cell-O double spindle boring machines lend themselves well to "Automation." When the bushings leave the grinders no attention is paid as to which end comes first, therefore, they are placed in the baskets at random but must have directional placement selections before entering the boring machine.

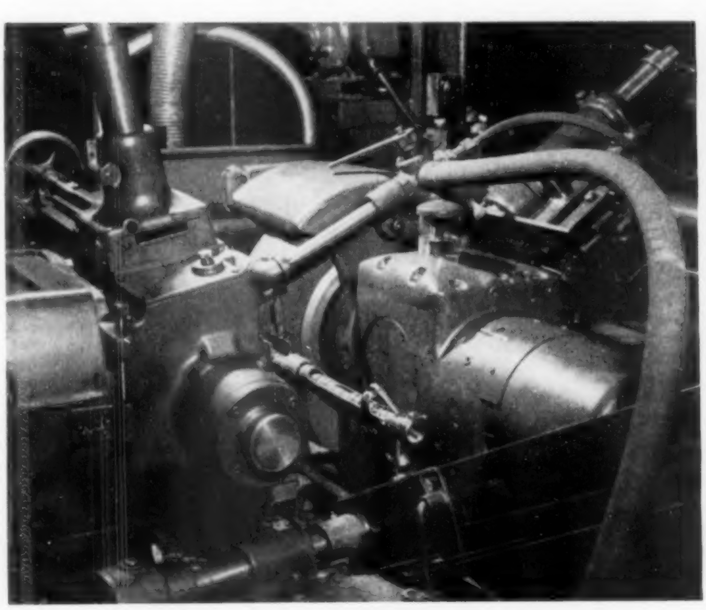
Parts are ejected one at a time from each magazine into spindles by air operated plungers. Each hollow spindle holds thirteen parts and when the fourteenth part is forced into the rear of the spindle, a completed part is ejected from the chuck at the front of the machine.

Bushings are located axially in the double diaphragm chucks by vertical plungers and drop automatically in front of the bushings to limit their forward travel through the hollow spindles. When the parts have been clamped in the desired position the locating plungers are automatically withdrawn into the housing of the chucks.

Valve guide bushings are precision bored on these machines at a rate of nearly 400 per hour. The stock removed from each bore diameter is 0.012 to 0.014 in. The work rotates at 3600 rpm. On the in-stroke, the tools are fed hydraulically at a rate of .007 ipr, removing 0.0055 in. of stock. On a return or out-stroke the feed rate is reduced to 0.004 ipr, and about 0.007 in. of stock is removed.

The bore diameter is held to within plus or minus 0.0005 in. of the desired size of the concentricity of the bore with the OD held to within .0015 in. total indicator reading.

A surface finish of approximately 120 rms. is carefully maintained. A smoother finish would be much easier to



Above, the valve guide bushings are shown leaving the centerless grinder. Here a restricting and directional device operates as the bushings are about to fall on to a continuous conveyor which takes them to the next operation. At left the incline conveyor is shown, at right is a close-up of the restricting and directional device which regulates flow of the parts.

A departmental view, showing in foreground the large hopper bin which carries the bushings into the first of the centerless grinders. The coolant return system is shown at right.

stablish; however, the bore is specified at this apparently ough finish with a definite purpose in mind. The engineers esponsible for product design maintain that their desire is o have the valve stem ride on the crest of the minute rooves which are created by the boring tool. It, therefore, ecomes the responsibility of the production engineer to reate and establish this condition.

In this case, we use solid tungsten carbide boring bars with the carbide tips of a different grade, brazed to the ends. These bars are made only 0.020 inches smaller than the bore of the bushing to insure the utmost available rigidity. Graduated dials at the front end of the boring bar upports permit accurate adjustment of the boring bar for ize.

Some of the valve guide bushings are bored on the Hoern & Dilts five-station double fixture continuous-type rotary boring machines. These machines do not lend themselves to automation, however, the five stations with two vertical spindles each, continue around the column of machine and as the spindles pass the operator, he removes the bored bushing and inserts unbored bushings which will have the operation completed by the time they return to the operator. Each of these machines can produce over 1400 bushing bores per hour. Each of the ten spindles passes the operator several times each minute.

Bored bushings are unloaded and two unbored bushings are immediately hand-loaded into the double diaphragm chucks.

The tooling is practically the same as on the two spindle horizontal Ex-Cell-O machines; however, on the Hoern & Dilts machines practically the full depth of cut is taken on the in-stroke of the tool.

Very little stock is removed due to bar-springback on this out or return stroke.

Here also, the bore size is controlled in setting up the machine with graduated dials at the top of the tool heads.

When the dials are rotated, the carbide boring bits are moved a distance corresponding to the graduations, by pivoting the tool heads.

We have learned, during the last year, by experience that improvements are always in order in automatic machine procedures. Time and practical application provides a real proving ground where good procedure can be made better, excellent procedures can be copies, and inferior procedures can be culled.

We have injected as the last machine operation on the valve guide bushing, a human element operation that controls quality, uniformity, and size of bores.

The precision boring machines maintain a complete tolerance of the bores to within 0.0005 in. which is normally accepted as an accurate production operation, however, the size control operation that we have added eliminates the plug gage inspection.

The bushing is held by hand and pushed over a tungsten carbide reamer which removes a maximum of .0003 in. from the bore. Thus sizing is controlled to remove from 0.0000 to 0.0003 in. from the ID.

Having such a light operation to perform, these reamers last indefinitely. Quality of the product is improved because the reamer removes the "fuzzy" edge that exists at the crest of all precision turned or bored operations.

When magnified many times, the crest takes on the same effect as the appearance of a razor blade edge under the same magnification. The reamer, being held to gage limit specification, would detect an oversize bore the same as a plug gage because there would be no torque felt with the hand, if no stock at all were removed. The operator must "feel" the metal contact.

We now have torque-control development to a point where plus or minus one ounce-inch can be consistently controlled, therefore, thinking toward the automation of this operation is now in progress.

The sizing operator places the bushing into trays, with separators, making a separate compartment for each bushing, to prevent nicks or burrs. The heavy or large end of the bushing is up and the aluminum trays have nine rows of twenty-two spaces.

The trays are loaded onto racks of an automatic dip-type phosphate coating machine where they are dipped into various liquid compartments and travel in an oval course until they slide from the racks onto a chute which leads to a roll-over operation.

An empty tray designed to fit snugly over the plating tray is placed into position and the two trays are rolled over 180 deg. emptying the bushings with the heavy end down into a shipping tray.

The shipping trays are made of sheet aluminum for lightness and non-scratching qualities. The trays are stacked on pallets six high, two end to end, and four rows wide. The trays are steel-strapped to the pallets. Each pallet holds 48 trays of 198 bushings each, or a total of over 8500 bushings. The pallets are picked up with lift type transporters and loaded onto trucks and sent to the engine-assembly lines.

Operating in this manner, we have recently produced over 127,600 bushings in two eight-hour shifts. This averages better than 132 pieces per minute. Our scrap percentage for this run was less than four hundredths of one per cent.

Above is the line of automatic screw machines where the bushings are turned, drilled, reamed and chamfered automatically. The incline conveyor at right supplies the hoppers of all the machines.

Broaching Applications for Cost Reduction

By O. W. Bonnafe
CHIEF RESEARCH ENGINEER
THE LAPOINTE MACHINE TOOL COMPANY

PERHAPS THE GREATEST factor in reducing broaching costs has been the development of better fixtures by the tool engineer. Better methods, automatic clamping and automatic ejection has resulted in the operator's merely placing the part into the proper nest and pushing the proper button. This has two important results. First, the operator can produce far more parts during any given period of the day, and with the reduced work load can maintain a higher average daily production. Second, better machine designs have aided higher overall production by increasing the production rate and decreasing the amount of down-time per machine.

Machine tool designs until a short time ago did not take into consideration, in many cases, the maintenance problems of the user. Average production, as a result, sometimes fell far below one-half the rated hourly production.

One manufacturer recently stated that, in their production line, a breakdown of a machine cost the company approximately $10,000 per hour for each hour the machine was out of service. This indicates that the machine should be designed for easier maintenance, and the slightly higher original cost of the machine would obviously be a good investment.

Present-day production still must be reduced to the lowest possible cost per piece. The modern machine is far ahead of what it was a few short years ago, and manufacturers have become very conscious of the best in design of workholding fixtures as they have come to the conclusion that they must be the heaviest possible. Most of them demand fully automatic operations such as clamping, ejecting and, wherever possible, operating from a hopper. But, at least at the moment, this cannot be applied in too many cases. The most specific demand is easier maintenance, because we all realize that no machine tool is capable of producing day in and day out, without some maintenance, and the demand is for something that can be repaired in case of breakdown in the shortest possible time.

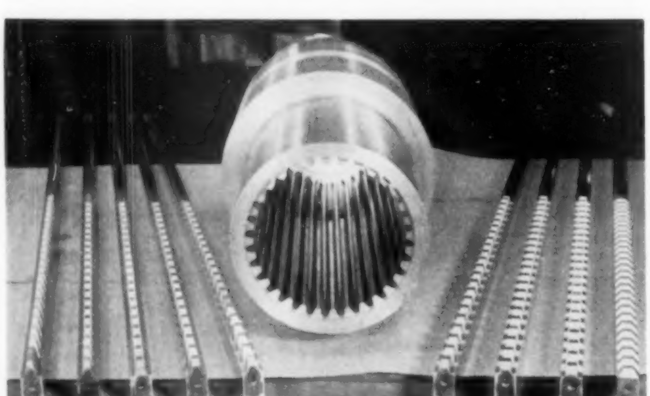


Fig. 1. Broaching of this universal coupling for a rolling mill was the alternative to prohibitively high production costs.

Furthermore, the tools which must be sharpened every so often must be placed in holders and many times in subholders to facilitate the handling of those sections which may require more maintenance than others. This is especially true of finishing sections which control size and finish. They should be placed in individual holders so that, when size and finish begin to get beyond what is specified, the section can be replaced in a matter of a few minutes. All these things have demanded greater care and better design from the tool engineer.

Recently several attempts have been made to use tungsten carbide tools, but with the exception of cast iron components, this has not been successful, and the only reason we know of is that the surface speed on modern broaching machines is still far from being what it should be. Although machines have been made with speeds up to 100 fpm, this is about one-third fast enough for the successful use of tungsten carbide. However, on cast iron several set-ups are now working very successfully using carbide-tipped tools. This in most cases is on flat surfaces, where husky holders are employed for standard carbide tipped tool bits, followed in most cases by two or three flat blades to shave the entire surface. I have seen several installations of this type where anywhere from 75,000 to 275,000 components are being broached between sharpenings, and the speed here is not too important. It seems that they work equally well at 20 feet per minute as at 100. Although there are not many machines made with this cutting speed, I think there are some being contemplated that should be in production before too many months.

An interesting experience might be cited here which, while not on a broaching installation, follows the same general rules. A small quantity of stainless steel parts were tooled on milling machines of apparently suitable size until suddenly an order came through to produce several times more of the part than the original order. The present machines could not be speeded up any more, and the purchase of additional millers to do the job was out of the question because

f delivery. Finally two very old but very heavy milling machines were tooled to aid production.

In the original setup, the cutters had to be sharpened every 25 to 35 pieces because of the accuracy and the finish required on these parts but as the big heavy machines were set up in a line, it was found that the same cutters were producing from 350 to 500 pieces between sharpenings and getting the same accuracy and finish. This serves to prove that the more metal you can put into a machine tool, the greater the accuracy and tool life is the result.

Let us cite a few examples of products where there are only a few parts to be produced, but they are of such a nature that to try to produce them without the use of broaches would result in considerable cost. Fig. 1 shows a universal coupling used in a rolling mill, which is over 40 inches long and 18 inches in diameter, and in which an internal gear form is broached. The ID is approximately 14 inches and it is a 3 pitch internal gear tooth form. To machine these splines by any other method but broaching would cost a considerable sum because of the size of the piece. A work support of the indexing type and a series of broaches was designed. The work support had to be of sufficient strength to support the parts and a series of 8 broaches, and by pulling one broach at a time, the gear form was produced.

Broaching made it possible to manufacture them at a cost so low in proportion to what it would have been by other machining methods that the purchase of a complete broaching machine and tooling has paid for itself in the machining of a few dozen rolls. One completed coupling was broached every 8 hours. The broaches were resharpened after 14 pieces.

Now for the extreme; a small part used in the cutting of radio part laminations. The ID dimension is a little over ¾ in., and the OD of the 16 splines is a little over 1 inch. No two of the splines are alike in shape or size. Formerly a good diemaker produced this die in one month's time. That may seem like a lot of time, but considering the accuracy and the irregularity of the part, it can be understood. Furthermore, only 0.001 in. tolerance was allowed. A broach was made to produce this die and the time required for broaching the die was less than 30 seconds. Each die is identical. In estimating the time of one diemaker for 25 days at \$2.00 per hour, the previous cost for the manufacture of this die was \$400. The cost of the broach was a great deal less than this and it should produce hundreds of dies of this type.

Fig. 2 shows a front spindle as used by a large automotive plant. As there are 8 surfaces on this that are machined, the previous method involved broaching in three separate operations, thereby using three separate machines with their fixtures and tools. The production on these three machines was in the vicinity of 240 parts per hour and naturally required three operators to do this. By redesigning the complete set-up using a heavier machine than formerly, the 8 surfaces were completed in one pass as shown in Fig. 3. The parts are now produced on one machine with one operator at a rate of 360 parts per hour as against 240 previously.

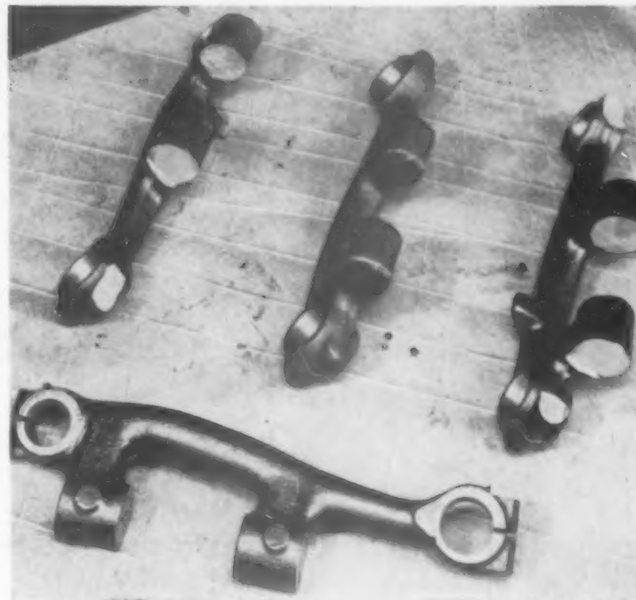
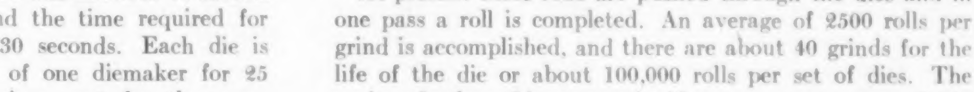


Fig. 2. This automotive front spindle formerly required three operations, using three machines. Redesigning the setup reduced the operations and machines needed to one.

In another case fluted rolls, used in the textile industry, formerly were manufactured by the use of special planers on which several sets of indexing heads and centers were placed. The tool was a single point Vee-type which took progressive cuts and indexed around to the next flute. The accuracy of these rolls is not of great importance but the finish must be especially smooth.

At present these rolls are pushed through the dies and in one pass a roll is completed. An average of 2500 rolls per grind is accomplished, and there are about 40 grinds for the life of the die or about 100,000 rolls per set of dies. The savings by broaching were significant, as an average of 120 rolls per hour are produced on a single machine, and by the use of various sets of dies of different diameters and different number of serrations, a standard broaching machine of normal capacity can be used. The finish obtained is far better than the old method and requires only a final polishing to produce the satiny finish required. Not only was there a great saving in labor cost, but to produce an equal number of rolls by the old method, the floor space required was about 20 times that of a broaching machine.

Fig. 3. At right is the redesigned machine setup for broaching the front spindle shown in Fig. 2. Eight surfaces are broached, and the new method enabled the part to be completed in one pass.



Design Factors in Investment Casting

By T. F. Frangos
HAYNES-STELLITE DIVISION
UNION CARBIDE AND CARBON CORPORATION

THE INVESTMENT CASTING process is becoming a highly useful tool with a wide field of application, and capable of important savings in cost. The possibilities are not yet wholly realized, but are being approached with each new step taken in the development and improvement of the process and its controls.

Heretofore, investment castings have been used for the most part as substitutes for machined parts. Their success has been in furnishing a part, either in an alloy more suitable for the purpose but not readily machinable, or at a lower cost. While this will continue to contribute to the growth of the industry, full utilization of the capabilities of the investment casting process will be realized only when parts are designed as castings. Thus, familiarizing engineers and designers with the process and what it offers will serve the double purpose of (1) encouraging the replacement of parts made by other methods, with investment castings where justified economically, and (2), encouraging the designing of parts as castings.

In investment casting a disposable pattern, oversize to compensate for shrinkage, is imbedded in investment material so as to be completely surrounded. It forms a one piece mold, with the gates and sprues. The pattern material is then burned out of the mold, leaving a cavity into which metal is poured and allowed to solidify. The casting is then removed from the mold.

This discussion will pertain to practice at the Haynes-Stellite Division, Union Carbide and Carbon Corporation. Disposable patterns are made of wax or plastic. They are formed, in quantity production, by injecting the wax or plastic into dies where the material solidifies.

Low melting point cast dies are suitable for wax injection but higher melting materials are required for plastic injection dies. Low melting point cast dies can be easily altered or repaired, and in event of serious damage can be economically reproduced from the master pattern.

On shapes that are relatively easy to sink, the cost of plastic dies is comparable with the cost of master patterns and soft metal dies. On more intricate shapes, plastic dies generally cost proportionately more. They are usually more difficult to repair, but they have a longer injection life and reproduce patterns with greater uniformity and accuracy.

Plastic injection costs are less than wax injection costs and when production requirements are high and the design is stabilized, plastic injection is recommended. On small volume runs, wax injection is more economical, but because of the lower per-piece cost of castings from plastic patterns, the high cost of a plastic injection die will usually be amortized in a range of 5,000 to 10,000 pieces and production beyond this quantity will result in definite savings. The choice between wax and plastic injection is determined by the size and shape of the casting and the quantity requirements.

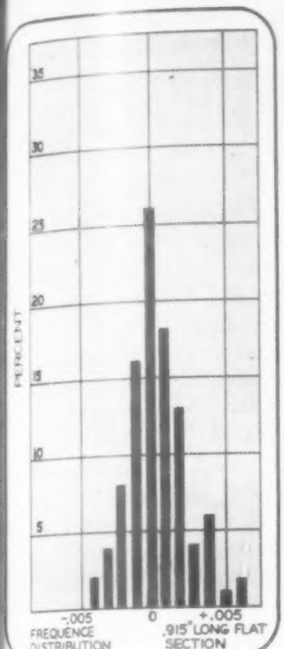
Occasionally, a potential user may want to determine the best alloy for an application before committing himself to the cost of tooling for volume production, or perhaps the design has not been stabilized. In such cases, it is not desirable to go to elaborate tooling until the design and alloy are crystallized. Test work can be done by having patterns machined directly in polystyrene plastic and then sprued up individually to be cast in the desired alloy. Instances occur when the shapes are too complicated to be machined in polystyrene. In these cases, simple one-cavity dies can be made from a master pattern, for the production of small quantity lots. Such temporary tooling is not suitable for quantity production, but is a relatively inexpensive way to test investment cast alloys or designs.

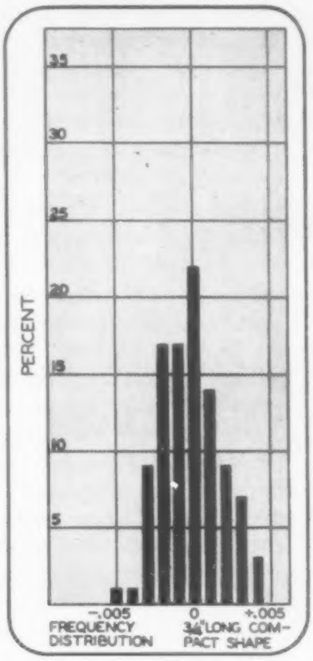
In order to keep the process competitive, it is necessary to include as many cavities as possible in a die, with good injection practice.

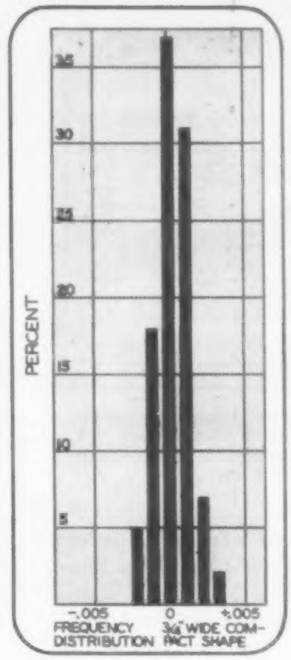
It is not advisable to put more than one item in a die, because the quantity requirements and the rate of recovery for each item usually vary, and the cost of blocking the die or splitting panels is usually impractical and expensive. The exception to this rule is where different details may be obtained by the use of interchangeable inserts in the die.

The tolerances that are held on investment castings vary with size and shape. The pattern material is also a contributing factor as greater uniformity is obtained with plastic than with wax. In general, casting tolerances of plus or minus 0.005 in. per in. of dimension are held, with a minimum tolerance of plus or minus 0.003 in. on dimensions of 5/8 in. or less. This rule is effective for dimensions up to 2 or 3 inches, although, frequently, proportionately closer limits are being held on larger dimensions.

A brief study has been made on the variations in dimensions of castings made from plastic patterns. A representative number of castings were checked and the results were







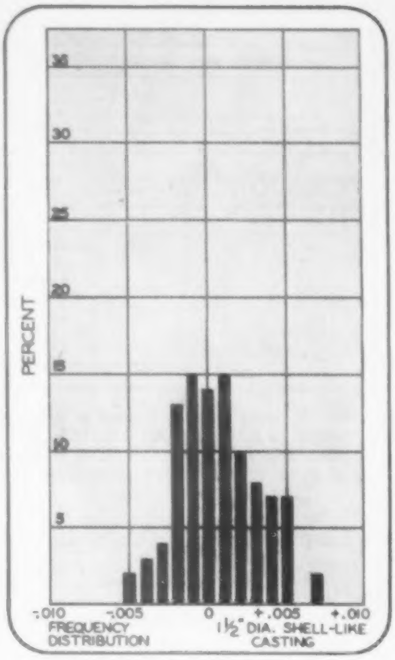


Fig. 1 (left). Frequency distribution of dimensional variations in casting a small, thin, flat part. Distribution of dimensional variations of a more compact part is shown in Fig. 2 (right).

Fig. 3 (left) illustrates another set of values for a small, compact part. There is less variation because of simplicity of the part. Fig. 4 (right) shows values for a shell-like bobbin case.

plotted around the nominal casting size to show the distribution of the cost sizes.

Here, for example, are the results obtained on a small, thin, flat casting used on a sewing machine. The dimension is about 9/10-in. long. (Fig. 1; Frequency distribution. Flat section, 0.915 in. long.)

One hundred castings were checked and 97 percent of the castings fell in a plus or minus 0.004 range, while 100 percent fell in a plus 0.006 in., minus 0.004 in. range.

A casting of compact shape will have less dimensional variation, largely due to the simplicity of its general shape, and relatively small length to thickness and length to width ratios. As an example, a small casting ¾ in. long x ⅜ in. wide x ½ in. thick, has the dimensional variations shown in Fig. 2 and 3.

Ninety-five percent of the castings fall within 0.007 in. range. The uniformity contributes toward minimizing finishing costs on this particular casting.

The high side of the graph is somewhat spread out. This is due to the occurrence of small positive defects of one or two thousandths height.

A check was made on the ⅜ in. dimension (width) after 100 castings had been touched on a sand belt, to remove the small positive defects. No appreciable stock was removed from the castings. The distribution is more symmetrical, having less distortion on the high side. All castings fall within a 0.006 in. range. (Fig. 3; Frequency distribution, ⅜ in. width-compact shaped casting.)

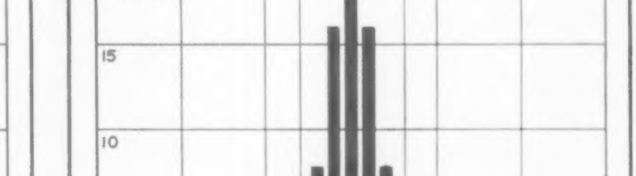
On a shell-like bobbin case, the casting variation across the 1½ in. diameter on 100 samples was found to be within 0.012 in. (Fig. 4.) There had been no sanding to clean the castings.

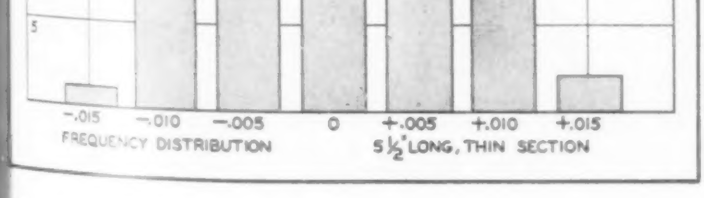
Ninety-eight percent of the castings fall in a 0.010 range on the diameter.

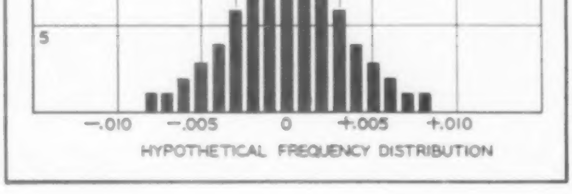
Another example is a 5-inch long casting with a thin cross section (Fig. 5). Lugs at each end anchor the casting firmly

Fig. 5. (right) illustrates a part which, because of its thin section, causes some warpage in casting. The distribution of dimensional variations is shown in Fig. 6 (below).

Fig. 7. (bottom right) shows the effects of tolerance ranges on production costs. A slightly decreased tolerance range results in a sharply increased percentage of rejects.







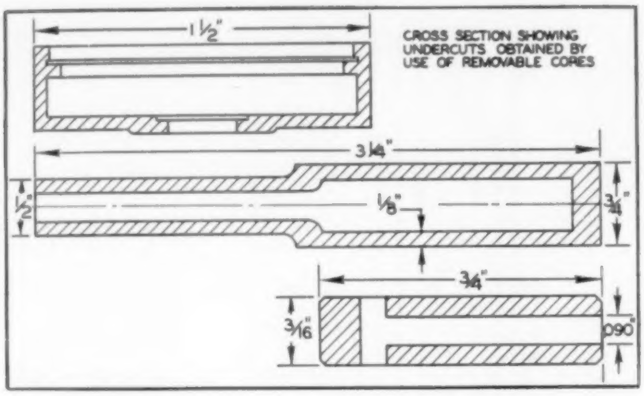


Fig. 8. (top) shows a method of providing for undercuts in casting design. Fig. 9. (middle) illustrates an instance where design of a blind hole in a long, thin part is impractical. Fig. 10. (bottom) shows the proper method for provision of such a hole.

in the mold, but the thin section causes warpage to become a significant problem. The frequency distribution is shown in Fig. 6.

There is a wider spread of the casting range than shown so far; to be expected in view of the overall length and high length to width ratio. A greater number of readings would show more even distribution, but enough data are present to illustrate the scattering of dimensions. A 0.040 in. range is held on all the castings while 95 percent of them fall in a 0.020 in. range.

Machining tolerances are not being held, nor are they claimed. This formation shows typical casting ranges that are being held on production jobs.

These data indicate how tolerance ranges can be established for non-critical dimensions. A 0.005 in. limit on the width of the feed dog casting, for example, may be common practice on a machined dimension, but if there is no need for such a limit it should not be specified on the cast dimension.

The effect of tolerances on cost can be shown as follows. Assume an arbitrary casting dimension frequency distribution shown in Fig. 7. (Fig. 7; Hypothetical frequency distribution.)

If plus or minus 0.003 in. limits are required, then 22 percent of the castings are rejects. A low yield of satisfactory castings is obtained and the cost of 100 percent dimensional check is involved. If plus or minus 0.005 in. limits are acceptable, then there are only 8 percent rejects; although all the castings must still be checked dimensionally. The lowest cost is reached when plus or minus 0.010 in. limits are permissible. Then there are no rejects and it is necessary to make only spot checks, or statistical checks, on perhaps one percent of the castings to insure the limits are being held.

Some examples of successfully-cast parts made according to good design practice. The exceptions are the long, tubular part shown

Some of the more pertinent points on designing for investment castings are illustrated by the following examples.

Undercuts—From the standpoint of cost, undercuts or negative angles are undesirable although, if their presence is imperative, they can usually be incorporated by the use of special cores. Fig. 8 shows the cross section of a bobbin case with an undercut.

Duplicate sets of cores are used. While one is in the die during the injection cycle, the other set is being separated from the previous injection panel.

Holes—Small holes can be cast in thin sections. The counterbore is influential in reducing the scrap rate due to core breakage. A 0.062 in. diameter hole, extending the full width of the casting, was cast without the need of counterbore. Blind holes are more difficult and an instance where a deep blind hole was impractical is shown by Fig. 9.

The length of this hole was over 3 in. and it was necked down near the supported end. A high scrap rate was experienced due to core shifts. This problem could have been licked if a preformed ceramic core were available, which would not become soft under the heat of the mold and metal, but the volume of the job in question did not warrant the cost of making such ceramic cores. Therefore, an alternate design was used in which the piston was made of two parts, the piston proper, and the cap.

An example of a hole which has support at each end, and can be cast successfully is shown in Fig. 10.

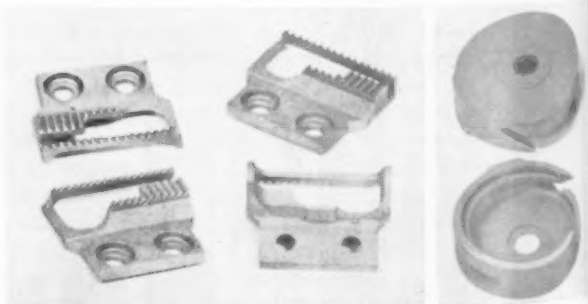
A non-machinable alloy is required for this part, and cast limits on the hole are satisfactory because they are gas ports. The investment material that cores the short holes serves to support the end of the long core and holds it in place, even against the impact of the metal entering the mold cavity.

Minor surface defects are more difficult to remove from holes than they are from external surfaces and this point should be borne in mind in the event that a clean surface is required in the hole. If a machinable grade of alloy is being used, and it is desired to hold close limits on a hole, it is advisable to include stock in the casting for subsequent drilling and reaming operations.

These examples of typical investment castings illustrate some of the capabilities of the investment casting process and shows how it is gaining greater effectiveness as a tool. There are designs that cannot be made at a practical cost except as investment castings.

Familiarization of designers with investment castings will automatically bring more applications to the industry and result in greater flexibility and versatility to their products.

During its development stages the cost of investment castings was relatively high, but as refinements are introduced in the process the costs become lower and lower and now attractive prices are being offered on more and more applications.



at left, where casting of a blind hole was impractical because of core shift. Correction of this design is shown in Fig. 10.

Forming Sheetmetal by the Marform Process

By R. B. Schulze
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The Marform process was developed to meet the aircraft industry's needs for a multitude of different parts with a low quantity of each part. In addition, a process which gave high quality with a low tooling cost was a vital object.

The Marform process can best be understood by first understanding the processes which preceded it: the Guerin process, and deep drawing with a steel die.

Steel draw tool construction is generally well known but a short review is in order. A steel draw tool consists of a male portion which is often called a punch or stake, a female portion which is often called the die, and a top and bottom pressure pad. The female portion of the tool can be eliminated in the case of a non-bottoming die in which case the bottom pressure pad becomes a draw ring. This economy can be made when the shape to be formed is one which naturally clings to the punch. The punch and die portion of the tool are of course necessary to define the shape to be made. The two pressure pads are necessary to confine the metal to a flat shape as it enters the die.

This latter statement is one which should be considered carefully, since it should be well understood. The flat metal blank used in forming a part must have an area almost equal to the final outside area of the shape being formed. When the shape to be formed is very deep, a blank of relatively large diameter must be used to form a part of small diameter. In other words, the original outer periphery of the blank must shrink radically in the forming operation. The metal blank, however, has very little rigidity of its own, and would therefore tend to cripple or wrinkle rather than shrink. Such wrinkles would prevent the metal from entering between the punch and the die if allowed to exist. The pressure pads confine the metal to a flat plane as it shrinks from a larger to a smaller diameter.

The pressure pads should squeeze the metal just tightly enough to prevent wrinkles from forming, since extra pressure would add unnecessary resistance to the flow of the metal into the die. The pressure required is not constant; it varies with the diameter of the blank and with several other factors such as the shape of the part to be formed and the pressure applied on the punch. However, the pressure is applied to the pads in a steel die either by means of springs or air cylinders in most applications. Springs provide variable pressure, but the variation is dictated by the springs and not by the requirements of the part. Air cylinders generally give a constant pressure for the full stroke.

On the other hand, the Guerin process substitutes for the normal metal female portion of the tool. However, there is no good substitute for the pressure pads employed in a steel die. Although the process of forming with a semi-fluid medium such as rubber was first experimented with a number of years ago, the process has risen to its present level of usefulness in the aircraft industry, since it offers an opportunity to save a considerable amount of money in tool cost on short production runs of applicable parts.

The rubber is contained in a retainer which is mounted on the upper platen of a hydraulic press. A platen is also mounted on the lower bed of the press directly below the rubber retainer. The lower platen is just large enough to match the size of the inner surface of the rubber retainer. The retainer and the lower platen therefore form a seal to prevent excessive escape of rubber from the retainer when pressure is applied.

The tooling employed with this process is simple, since it consists only of a male punch. It is even further simplified by the fact that the forming operation is accomplished with a pressure stroke which is softened by the rubber, so that softer tooling materials such as Masonite may be employed. Tooling cost is, of course, much less than that of a complete steel tool for the same purpose.

The Guerin-process tools are placed on the lower platen for the forming operation and the metal blanks to be formed are placed on the form blocks, although locating pins are generally employed to ensure proper location of the blank on the tool. Any arrangement of form blocks can be placed around the surface of the lower platen.

Satisfactory results are obtained with the Guerin process when the stamping operation involves a straight bend in the metal, stretching of metal, or a combination of the two. This is because there is not any tendency to wrinkle in bending metal on a straight line or in stretching metal into a shape such as a concave flange, or a stretched depression such as a bead. However, in shrinking metal into such a shape as a convex flange or a deep drawn cup, wrinkling may result.

This inability of the Guerin process to shrink metal is due to several factors. First, the pressures employed have not

been of a high enough magnitude to solidify the rubber to a degree which would give it sufficient local stiffness to prevent wrinkles. A simple increase in pressure would not solve the problem, since the basic difficulty is the fact that some movement of the retainer must take place against the tools and forming blanks before any pressure is built up in the rubber. In other words, wrinkles can begin to form before any pressure is built up in the rubber to prevent their formation. This is true regardless of the eventual pressure available, and is important, since it is difficult to remove wrinkles once they have begun to form.

For example, the Marform process utilizes the male punch employed in the Guerin process but it also requires a single plate surrounding the punch on which the flat metal rests. It is unnecessary to make either a female die, pressure plate or draw ring. The elimination of half the parts formerly required for a drawn part saves more than half the cost of the tool in many cases. One reason is the fact that the female portion of the tool is often the hardest to make, since it is more difficult to work down in a hole. The second, more important reason, is that the matching problem between the two halves of the tool has been eliminated.

The Marform punch can be made of Masonite for short runs on soft materials. Cast Kirksite can be employed for longer runs or where harder materials are to be formed. However, steel punches are generally employed for production runs, especially on harder materials. The flat plate on which the metal rests is always made basically of steel. This plate must be flat and smooth but the fit between it and the punch is unimportant except when forming very thin metal such as ten or twenty thousandths-thick stock. A thin Masonite overlay is often employed on the steel plate on short runs to save the cost of grinding the surface of the steel plate. The inside periphery of the plate, where it surrounds the punch, and outside periphery of the plate can be torch cut in most instances.

Another advantage of the Guerin process over steel dies is that set-up time on a tool is negligible and any arrangement of tools can be distributed around the lower platen. This is an important cost item when compared to the time and effort involved in setting up a steel die. The Marform process again strikes an effective compromise between the two. Here the set-up time on a tool is relatively small, since the male and female portions of the tool do not have to be matched and since more than one form block can be used in one pressure plate or in separate pressure plates on the same machine. The pressure requirements and depth of stroke must of course be equal, however, for all parts formed at the same time.

As was stated earlier, the Marform process was designed to combine the forming ability of a steel die with the economical tooling of the Guerin process. Although the Marform process does not give the embossing definition of a steel die, at least in its present state, it outperforms a steel die in many cases. For example, the forming ability of a tool or material is generally judged on the basis of the depth of round cup it will draw on a given size of punch. This can also be stated another way by saying that the basis of drawability is the percentage reduction in area which can be made on a blank in one forming operation.

A 40 percent reduction in area is generally expected on a steel die when forming aluminum alloys. A reduction in area of 50 percent can be attained if extra diligence is exercised. However, a reduction in area of 57 percent is considered normal in Marform work on the same material and figures as high as 70 percent have been attained in testing operations.

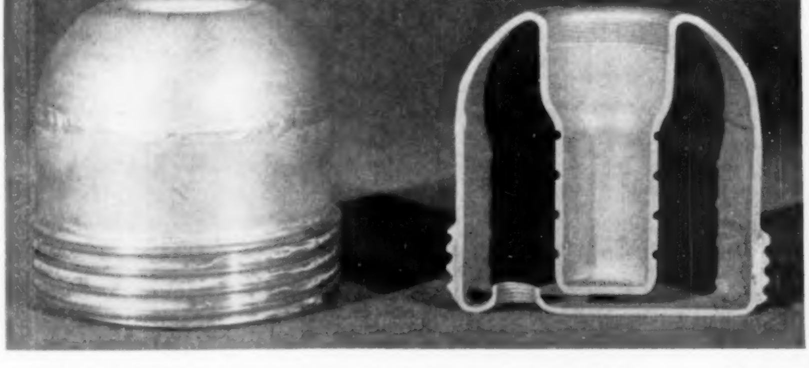
Similarly a cup depth equal to the radius is normally expected from a steel die while a depth equal to 1½ time the radius is normally expected in Marform on the same material. Depths equal to 1.2 times the diameter or 2.4 times the radius have been attained in certain cases. This means that the Marform process can sometimes form a part in one operation which would otherwise require two operations.

There are several apparent reasons for this added formability. One is that the rubber has a certain cushioning effect and therefore prevents rapid application of strain at any point on the metal in contrast with the situation in a steel die where localized applications of strain may on occasion be quite severe.

The rubber also exerts a lateral pressure during the forming operation which is a direct result of the applied forming pressure. This lateral pressure has the effect of locking the metal already formed to the male portion of the tool. An accumulation of strain at the punch radius is prevented, and the strain is distributed uniformly over the complete surface of the piece to be formed. The importance of this is demonstrated by the fact that when failure occurs on most steel die-formed parts, the top pops out of the part, with the failure along the line of the punch radius.

Prevention of strain concentration at the punch radius not only enables the part to be forced deeper, but also causes the part to be more satisfactory in certain applications where uniform thickness is important.

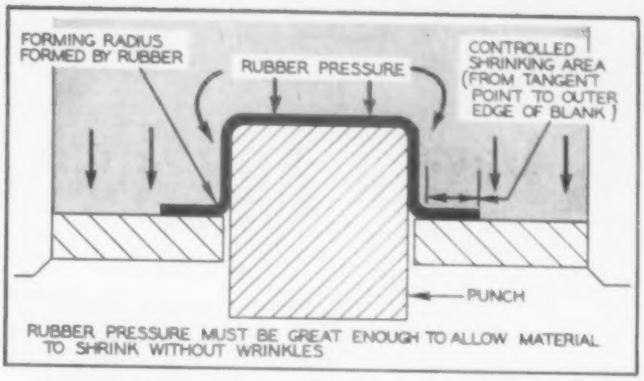
Another related advantage is the fact that the rubber locks the material against the punch. This arises from the phenomenon that local elongations in metal can safely be higher than elongations over a relatively longer gage length. The rubber automatically causes the metal to be strained over a shorter gage length by locking it just above the instantaneous point of forming and therefore provides the



Above is a cutaway view of the upper half of an ignitor head, which is identified as that part above the weld including the cylindrical portion extending down into the lower shell. This much of the illustrated part was made by the Marform process in five operations.

Nine operations would have been required by more conventional operations. At extreme right is a part having a diameter of 2¾ inches and a depth of 2⅜ inches, formed in one operation by Marform. Conventional method requires two operations.

Above is an assortment of metal parts formed by the Marform process. The parts shown range from 0.010 aluminum to 0.109 deep drawing steel and represent a large variety of shapes and sizes which have been successfully formed by this method.



This sketch illustrates the Marform punch and plate on which the as yet unformed metal rests. These two elements constitute a Marform tool. The rubber in the Marform retainer is also illustrated along with the fact that the rubber pressure is exerted in all directions against the part.

elongation available from the shorter gage length.

Further, with the Marform process the machine can provide an exact required pressure on the material at each desired depth of stroke. This pressure can be varied in either direction: it can start low, be increased, and then drop off, or it can gradually be increased from start to finish, or it can be started at a high value and then dropped gradually to a lower value. The pressure variation can be infinite within the minimum and maximum values, and therefore it is not a series of steps.

Another advantage from a forming standpoint is the precision with which a given shape can be formed. Sheetmetal parts can be made to a tolerance of plus or minus 0.002 in. A tolerance of plus or minus 0.005 in. is commonly obtained on parts where the shape is sufficiently rigid to maintain such accuracy.

Material as thin as 0.010 in. has been successfully formed, and a 0.012 in. gage cup was deep-drawn to the point where the depth of the cup was 0.9 of the diameter of the cup. Gages as thick as 0.675 in aluminum alloys and 0.102 in 1010 steel have been formed. This is not necessarily the maximum but represents the thickest gages formed to date.

The problem of applying finishes to formed shapes is sometimes critical from the economy standpoint. This is particularly true of polished surfaces. It is much more economical to polish material in the flat state and then form the parts, but this results in marred finishes when the normal processes are used. However, round cuts have been formed on the Marform machine successfully where the material had been previously coated with such finishes as vinyl, aircraft paints and crackle paints. The experiment was also performed with polished material.

Tapered shapes are a major forming problem. Any tapered shape tends to wrinkle, because of the distance between the punch and the pressure plates of the die at the start of the forming stroke. Tapered shapes are important to industry because they are attractive, because they will stack better, and because they save metal. While it is difficult to quote a rule on what can be accomplished with our limited experience to date, the following examples will serve as a guide as to the severity of taper which can be formed without wrinkles. Consider a four-inch diameter on the top of the punch and with a taper outward toward the bottom of the punch. On such a punch the gap could be 0.5 in. between the punch and the supporting pressure plate, for 0.025 in. thick steel. This gap can be increased to ¾ inch with the gage of the steel increased to 0.050. The gap can be 3/16 of an inch with 0.025 gage aluminum and ⅜ inch with 0.050 aluminum. Developments under way at present may result in a radical improvement in the permissible taper in one operation.

We are currently using presses of 800 ton and 3500 ton capacity in Marform work. The 800 ton press is used in conjuntion with a Marform unit which has a 16 x 18 inch forming area, and provides a forming pressure of 5,560 psi. The 3,500 ton press is used with a 28 x 31 inch forming area which offers a theoretical forming pressure of 8,060 psi. However, utilization of this maximum pressure increases the maintenance cost on the equipment, so the press is not used 7,000 psi. The pressure noted can be directly translated into working pressure on the metal in the Marform unit itself.

Capacity of the small press enables us to obtain 120 cycles per hour, which may result in a multiple of that number in pieces per hour since often more than one piece can be formed at one time. The large press operates at a speed of 60 cycles per hour, and this rate can also be multiplied by the addition of more parts in the same stroke. This speed of operation is based entirely the speed of the hydraulic press equipment on hand and can be increased to match the speed of any faster hydraulic press. No attempt has been made as yet to apply a Marform machine to a mechanical press but we believe that the application would be successful if the press had sufficient daylight opening and the proper power.

Design and Use of Die Casting Dies

By Charles M. Franklin

MASTER MECHANIC, ROCHESTER PRODUCTS DIVISION
GENERAL MOTORS CORPORATION

DIE CASTINGS PROVIDE an important tool for reducing fabrication costs to a minimum. This is due to the inherent nature of the process, which makes it possible to produce castings with holes and surfaces that require no additional machining at a cost economy beyond that of other methods. Some design and production factors include:

Reduced material cross section is possible with this method.

Uniformity of parts produced to tolerances of such close dimensions that no additional expense need be incurred to finish them.

Holes can be cast to size tolerances equal to those that are drilled, reamed or counter-bored.

Holes and contours are possible which would be excessively costly to produce by some machining operation such as broaching, profiling, turning or boring.

Surfaces require no further machining operations and are also suitable for the application of paints and lacquers.

Surfaces require a minimum of finish for plating and polishing.

And added to all of these possibilities is the low cost of producing such parts by die casting.

Perhaps seventy-five to eighty percent of the total die castings in this country are zinc base alloys, fifteen to twenty percent are aluminum base and five to eight percent are magnesium, copper base, lead and tin.

Commercial die casting has become quite a business and the greater part of the production is handled by these commercial die casters.

Many unique designs of die casting machines were the forerunners of our present-day modern die casting equipment. It was not until about 1907 that the "goose-neck" type was introduced and about 1935 the "cold-chamber" was introduced. The cold chamber is used more for the higher melting point metals.

The earlier machines, being hand operated, did not produce uniform castings; hence the introduction of air and air-operated plungers for metal displacement. At present many of the machines are actuated by complete hydraulic and electric systems so interlocked that a continuous operation of closing, shooting, holding and opening is possible.

The movable platen, actuated by hydraulic pressure, closes the die, which after a short interval is shot (or injected) with molten metal. This metal is forced into the die by a hydraulically-operated plunger driven into the goose-neck which is connected to the die by means of a nozzle. After a suitable wait period, the dies are opened and the part is automatically ejected to a point where it is either removed by the operator or drops out of the machine for further fabrication.

Pre-Design Considerations

Die design required considerable ingenuity at times and the designer is confronted with many problems which sometimes must be worked out with the product engineer before it is possible to complete the actual die design.

A die that is properly designed will, of course, operate more efficiently and the maintenance problem is very much reduced. Good design can also reduce original die cost.

Many factors must be taken into consideration in the die design. These include size and shape of the part, coring problems, production requirements, the size and type of casting machine required or available. These factors put together determine the number of cavities, required and or possible, in the die. Multiple cavities in some cases can be designed for a die economically, and more than pay for the slight additional cost.

Designing a Typical Die

Inasmuch as the basic design of the more extensively used die casting machines are the same, the problem of die design is reduced to somewhat basic principles (Fig. 1).

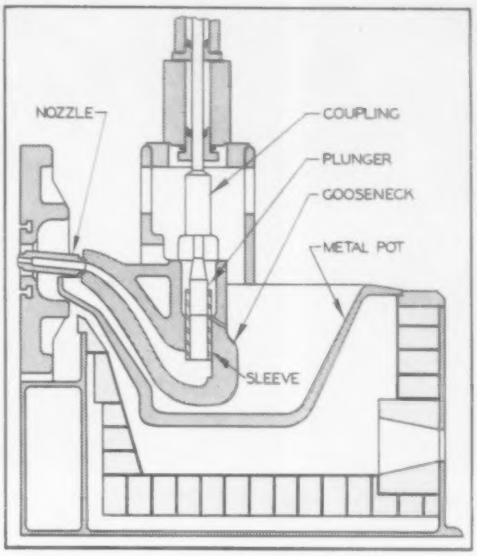
We have then a cover half and an ejector half. These are usually aligned by suitable guide pins and bushings (Fig. 2).

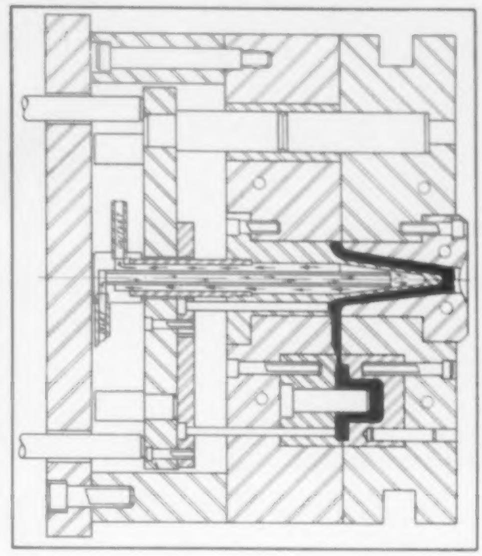
The cover half is mounted on the stationary platen of the machine and is registered to nozzle position by a suitable locator or register plate. This half also has the function of carrying the metal opening or sprue.

The register plate and sprue block is usually designed in such a manner that it is easily replaced in event of damage to the nozzle seat. In most cases, it is desirable to cool the sprue for operating purposes. Cooling can be accomplished in this type of sprue block by welding the parts together and attaching the water and drain lines accordingly.

Fig. 1 (right). Nomenclature and fundamental parts of the die casting machine.

Fig. 2 (far right) illustrates the construction principles of the die casting die. The two halves are aligned as noted by pins and bushings; the cover half is registered to nozzle position by a locator.





In some cases, shallow cavity openings and cores are also a part of the cover half.

The ejector half is fastened to the movable platen and consists primarily of the cavity plate and ejector box, or in some cases riser blocks and ejector mechanism. The cavity usually carries the major portion of the cavity and cores.

This is clamped to the movable platen by suitable bolts or bolts and clamps.

Some part designs necessitate the use of side or angle cores, which are pulled at the proper time by various types of core-pulls.

The more simple side core-pulls are operated by horns or cams and rolls which contact the core-pull in the proper sequence of die opening and closing. Core-pulls are sometimes operated by rack and pinion devices; other cases, by hydraulic cylinders, properly mounted and timed by the cycle control on the machine. The horns and cams are usually mounted to the cover half of the die, whereas the hydraulic core-pulls are generally attached to the ejector half.

Side slides, which make re-entrants or bosses that are above or below the normal surface, are necessary in some cases to produce the desired part contour (Fig. 3). The side slides are operated in essentially the same manner as side core-pulls, and often times carry core pins. The side slides may form from a small portion of one side to as much as one-half the contour, and may operate parallel to or at an angle from the parting line of the die. In some cases, it has been necessary to operate side slides and/or cores from all four sides of the die.

Generally it is desirable to lock the side slides into a fixed position due to the metal pressure build-up. This can be accomplished by locking plates mounted on the cover half and contracting the side slides when the die is in the closed position. These locking plates are designed with an angle that contacts in the last one-half inch of die closing.

Cavity design not only determines whether the use of side slides is necessary but also whether a solid die, or cavity inserts should be used.

In the design of some of the smaller parts, it is found desirable to use die inserts mounted into cavity plates or chase plates. Should an accident occur it is easier and less expensive to make new inserts for replacements. In other cases, it is more desirable to build up the inserts into a unit than to machine the insert entirely from the solid (Fig 4).

With larger parts, such as bumpers and grills, it is of

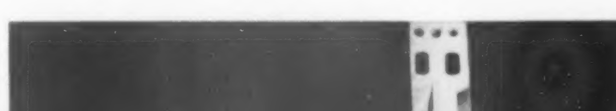
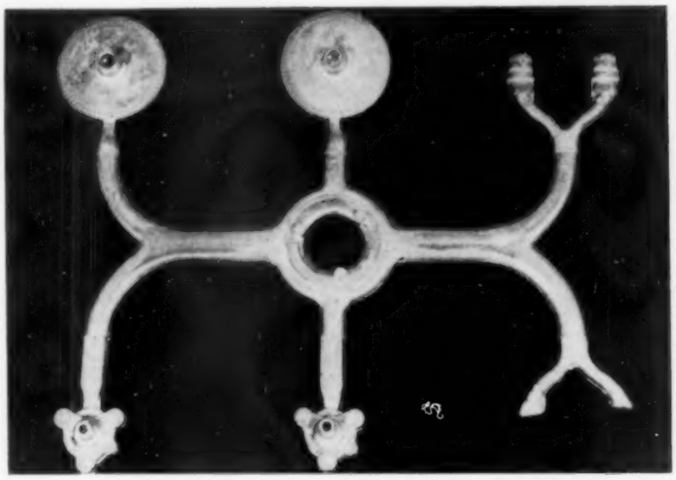


Fig. 3 (left). The use of side slides, necessary to make bosses which are above or below the normal surface, is illustrated here. Part contour affects their design and application. As shown in Fig. 4 (right), the use of die inserts depends upon part design. On smaller parts, it is cheaper to use inserts mounted into cavity plates or, as can be seen, it may be more desirable to machine the insert entirely from the solid. Choice of cavity design, whether solid die or cavity inserts, is governed by part characteristics.



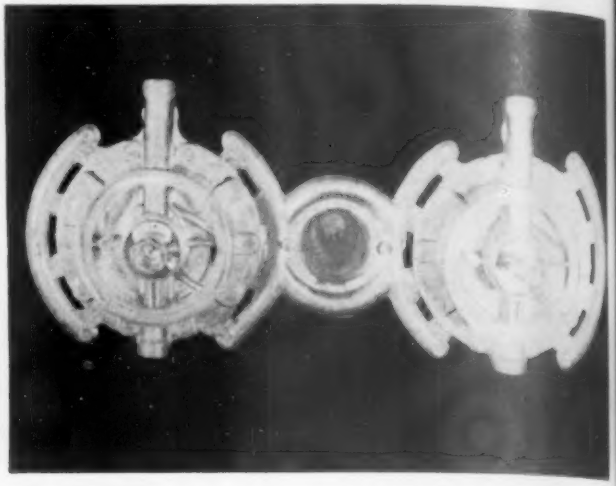


Fig. 5 (left). Runners should be as small as is possible to carry molten metal from the sprue to the gate of the casting. Fig. 6 (right). In some cases pockets are necessary to draw off a small amount of metal as well as entrapped air.

greater advantage to make the cavities from a solid piece of steel.

Alloy Castings for Dies

Recently some experiments have been made in the use of precision alloy iron castings, which require a minimum amount of finishing, such as cavity plates for zinc base die casting dies on hardware parts. These tests are not completed but may find a place in the die cast industry.

Starting at the base of the sprue, runners are cut toward the cavity or cavities and these are finally blended into the gates of the castings.

The runner should be made as small as is possible to carry the molten metal from the sprue to the gate of the casting. The cross section of the runner should be half-round, or a variation of such, so that it releases freely from the runner recess and the metal does not tend to chill through in making its way to the cavity. Avoid the use of a wide thin runner (Fig. 5).

Gates are the entrants, or openings, into the cavities from the runners and can assist many times in producing results in cavity flow that determines the soundness of a casting. This size of the runners and gates are usually determined by the size of the castings, the distance traveled, and the speed with which the cavities can be filled through the gates.

In addition to the proper gating of castings, it is sometimes necessary to provide suitable venting, to produce soundness in castings. The venting sometimes consists only of thin, wide openings that relieve the trapped air and produce a thin flash which quickly solidifies on the die surface without much metal flow.

It may be necessary to make pockets relatively close to the cavity and actually draw off a certain amount of the metal as well as trapped air (Fig. 6). This is particularly true in hardware castings where finish is required.

When considering the size of the runners, always bear in mind that the runners, while necessary, must be remelted. Runners and sprues can become a very costly re-melt factor if not watched closely.

Most castings have some kind of cores. These can vary from perfectly round cores to extremely intricate cores that are sometimes preferably built up or made of several pieces, suitably held together by some means, so that they appear as a solid unit. In some cases, it is desirable to hold the cores to very close tolerances due to part requirements, in other cases more latitude can be taken.

Subsequent fabrication costs in many cases determines coring design. I have successfully cast small holes 0.028 in. diameter by $\frac{5}{64}$ in. deep and made thousands of castings without pin breakage (Fig. 7). Also, I have cast three-sixteenth diameter holes with $\frac{1}{32}$ in. taper more than $2\frac{3}{4}$ in. deep. These corings eliminated highly difficult and costly drilling operations.

Ejecting Part from the Die

In ejecting parts from the die, consideration must be given as to where, as well as how, the part is to be ejected. In most cases, simple round ejector pins are used. In some cases, the bosses or projecting points of the part lend themselves readily to ejection points.

The ejector pins are mounted on plates in the ejector box or between the riser blocks. As the die opens, the ejector pins on the machine force the plate forward, thus ejecting the casting.

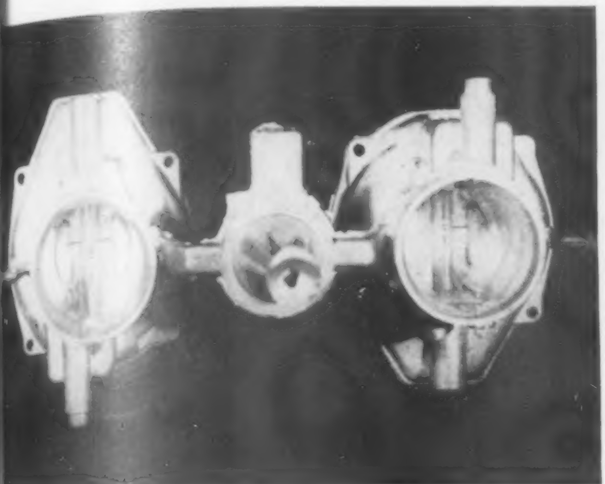
To return the ejector pins to the casting position, push-back pins, mounted in the cover half, contact mating pins on the ejector plate. The plate is thus pushed back when closing the die to stop pins for locations.

Simple or direct ejection of the part is not always possible due to die operation interference and necessary length of ejector pins. In order to avoid manual ejection, it is possible to design this operation successfully into a mechanism operating in sequence of opening and closing of the die, thus speeding up the operation and reducing the manual hazard contributing to die maintenance (Fig. 8).

Sometimes the casting shrinks to the coring or male members on the cover half and necessitates that the casting be pulled from this section in some manner. This can be accomplished by the side slides, which can be made to hold the castings either by re-entrants in the castings or by the bosses or extended surfaces of the castings. The side cores may also be suitable for this operation (Fig. 3). This can further be accomplished by using the ejector pins and ejector holes. The ejector pins being cut on the ends, with a back taper, thus holding the metal until the ejection has taken place.

Occasionally the part must be as nearly flat as a machined surface; yet due to certain bosses or extended surface requirements it cannot be suitably machined. This can complicate the ejector problem especially if there is the added problem of ejecting this part from long cores and contours requiring excessive stripping pressure (Fig. 9).

I have reference to a carburetor bowl cover which has a rather deep pump well, almost straight for approximately two and one-half inches. This, with other coring and cavity problems could not be ejected in the conventional manner and produce the mating surface requirement of flatness. A



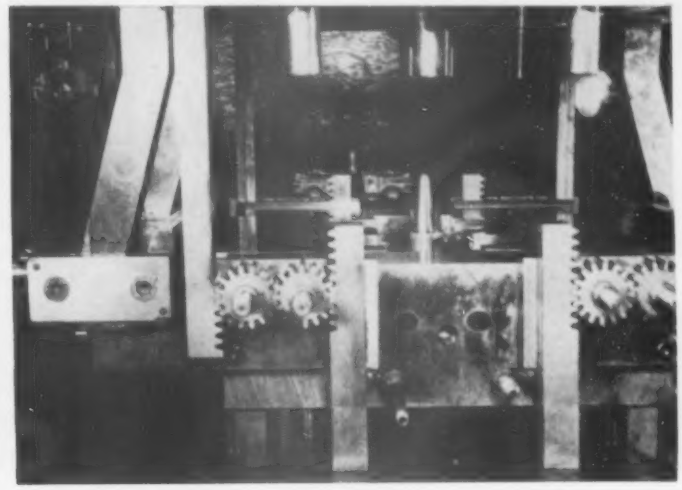


Fig. 7 (left). Successful planning of coring design is illustrated above in this casting of small holes in the part. Fig. 8 (right) shows a method of designing for casting ejection in the event that the part cannot be ejected without resorting to manual means.

rather complex ejector mechanism was required, and this resulted in making the die plate, on the ejector half, move forward about one inch; then the ejector plate was in turn moved forward to complete the ejection operation. As the die closed, the operating mechanism returned the various members to their functional positions.

Control of Flash

Flash is prevalent on all die castings. This is sometimes intentional as in the case of venting, or in the matching of cores or other parts of the die. It also results from the use of the die and must be taken into consideration in the design of the die, as many of the subsequent fabricating operations are dependent on the condition of the casting as it is produced by the casting department.

Inasmuch as flash removal problems must be taken care of, it is desirable in most cases to have approximately 0.015 in. thickness of flash for good press trimming. This is true especially where the mating surfaces of the cover and ejector dies become damaged by flash around the cavity openings. I recommend a recess 0.015 in. deep by 3/32 in. provided at this point in the cavity side of the die.

Another flash problem that is often a source of trouble in the fabrication of parts is caused by the build-up between the side slides. This can be controlled in most cases only by constant vigilance on the part of the operator. If not controlled, it will cause a lot of scrap and may cause serious damage to the die as well as loss of badly-needed production. A well-trained operator is an important factor in the die casting department, as much of the die maintenance can be controlled by a careful, conscientious operator.

In designing die casting dies, it is advisable to use the maximum taper or draft possible. This applies both to cores and cavities, since it reduces the stripping and ejection problems as well as maintenance problems.

To produce castings at the highest possible output per hour, it is necessary to cool the dies and other sections to set the metal faster. This is accomplished by water lines or chilling chambers so designed that a suitable passage of water controls the die temperature as required. These are hooked up to control valves, operated by hand, to give the desired condition.

In finishing lock parts, it has been found advisable not to attempt to broach or shave the holes to size. In taking the flash from the cored openings, the tools are made to break the flash to the cored size only. Any attempt to broach-size or shave a hole or contour results in very short life tools and distorted parts.

If a part required any additional machining, it is desirable to remove sufficient material to get under the surface of the casting.

Metal temperatures and die temperatures play an important role in the production of sound castings. This is true particularly in carburetor castings. A cold die will not fill properly, thereby causing leakers and scrap. A hot die will not set the metal fast enough and causes shrink sections which can also be leakers or scrap. Hot dies also can be responsible for slower machine cycling or reduced production.

Porosity is sometimes caused by an increase of plunger pressure but proper venting must also be given consideration.

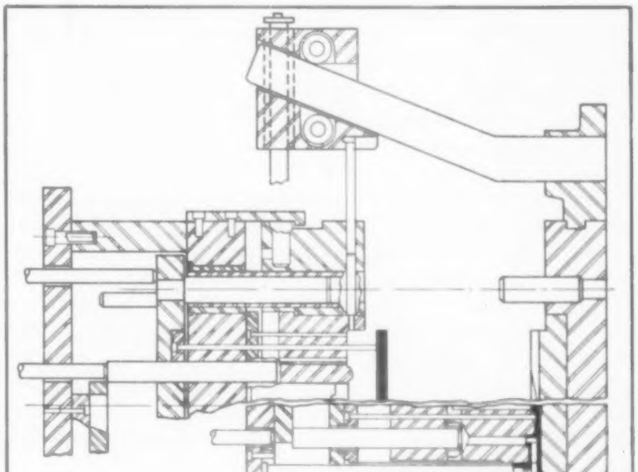


Fig. 9. In the part above, it is required that the surface be almost as flat as a machined surface, yet bosses prevented machining of the surface. A number of complications in ejecting arose, necessitating a rather intricate ejection design.

The Mechanization of Parts Handling

By C. E. Kraus
PRESIDENT
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In the manufacture or production of quantities of duplicate items, progress, which means not only reduction in total cost but increase in uniformity and quality, has resulted from increased mechanization of all phases of the operations involved. The ultimate or complete mechanization, where raw material is dumped into one end of a completely automatic line and the end product is ready to ship to the consumer, is possible and practical only occasionally.

Before actually discussing any specific mechanisms, it may be well to go over some of the many factors that enter into determining the mechanisms, and those factors involved in selecting practical applications.

Economic Justification

The most important, of course, is the economies of the applications. The present method of handling workpieces, whether entirely by hand or semi-automatic, results in a certain overall cost picture. This cost picture is based upon the average operating rate, including down-time for personnel reasons, down-time due to the present equipment involved, factors such as rejects or average quality produced, cost of labor and supervision, and other overhead costs. With more complete mechanical handling of pieces, the net cost per unit piece is affected favorably by many factors. Generally, the average production rate will increase, the rejects due to throw-out mechanisms and interlocks may decrease, and the general quality of the workpiece may increase due to increased uniformity. With automatic handling, the increased production rate that is sometimes possible actually shows a decrease in the number of processing units required, and frequently a decrease in the machine investment that is necessary. Balanced against these benefits is a certain reduction of versatility, which may be an important factor if a variety of pieces are to be handled or if design changes are frequent or extreme.

Maintenance of any sort of equipment is always a factor, and automatic equipment is no exception. It is customary to assume operating efficiency figures of from 70 to 80 percent on an average, for machines which are loaded and unloaded manually. These machines will not show 100 percent efficiency by the simple expedient of making the loading and unloading automatic.

The first step in analyzing any handling application is to study the nature of the workpiece itself. The ideal workpiece is stable in shape, uniform from piece to piece, has no misformed pieces, is free from foreign material, is simple to convey by chutes, is required in reasonably large quantities, and is reasonably simple to position. As far as application to a machine is concerned space limitations may affect the equipment very definitely, and sometimes the interlocking of the equipment with the machine cycle is a problem.

Two other factors should be kept in mind with all applications. Many of the unfavorable characteristics of the workpiece can be eliminated by a change in design. Sometimes holes or notches may be added, which serve no useful purpose other than to assist in orientation or positioning problems. Sometimes additional operations can be advantageously added to the workpieces in the bulk, which will simplify handling; such as tumbling, and in some cases, screening of chips or even thorough degreasing. The second factor is often overlooked but is of considerable importance: the experience that the manufacturer has had with the use of automatic handling equipment. A plant that has no such equipment would be a poor place to put, at least initially some of the more complicated types of mechanisms. Experience in using and maintaining such equipment must be developed, just as experience in using and maintaining any other high production tools is necessary. Some of the very simple types of hoppers, chuting and inserters can be applied almost anywhere, but as the complications increase, such experience becomes more and more essential.

The mechanisms involved can be divided for convenience into four groups: the prime sorters or feeders, usually referred to as hoppers or hopper feeders; the secondary sorters or orientation devices; the conveying means; and the final positioning mechanisms. This grouping is necessarily arbitrary, as they blend and combine in endless variety, and this paper will be restricted to the first group.

Hopper Design

Fig. 1 shows a simple controlled-gate, external outlet-type hopper. This particular hopper is often called a pin gate, inasmuch as the gates are formed by pins which frequently are turned to special shapes and spaced around a rotating disc. They may be used for orienting, depending on part complexity, and frequently show high delivery rates. Well-known examples are the standard ratchet-driven rivet hoppers and types used to feed caps for beer and soft drink bottles. They may be inclined, have single or multiple chutes, ring-type exits, and may be indexed or continuously driven or varied in many ways to suit the piece part needs.

A widely used modification of this general type is the inclined internal gate design, which uses a slowly rotating suitably grooved sorting disc. Standard hoppers of this type

have been successful for such parts as screws and other simple parts.

Fig. 2 shows another type of gate hopper. This is usually found in small sizes used for eyelets and similar pieces. It consists of a stationary cup with a fixed, shaped gate attached to the chute. The pieces are wiped past this gate in a steady stream by a rotating wire brush. If placed horizontally, the brush omitted and the parts rotated by resting on a spinning disc, we have an arrangement commonly used for delivering cans and bottles. By adding deflectors and guide rails this type can handle various covers, fuse bodies and similarly proportioned pieces.

Another simple feeding principle used particularly for packaging fixed numbers of pieces in groups is drawn in Fig. 3. A slide having the requisite number of pockets is slid under a load of pieces in a hopper, and when pulled out, the pieces drop into a suitable funnel chute. When used for pins or odd shapes, the action frequently makes use of reciprocation or vibration. For high delivery, the slide may be a continuously or an intermittently rotated disc, and when used with timed gating, may be modified for accurate counting of large numbers of pieces, such as pills or balls.

A pocket type used for continuous timed delivery of one piece at a time is illustrated in Fig. 4. A counter-rotating brush prevents jams and the feeder is used for such items as small tubes and pop sticks, at a fairly high delivery rate. Lengthwise orientation in loading is essential.

One of the oldest principles used in parts feeding is illustrated in Fig. 5. This is the reciprocating-tube arrangement where a chute, entering at the vertex of a cone, is given a vertical back-and-forth motion relative to the parts held in the cone-shaped container. Used for pins or simple shapes, it is successful with reasonably uniform parts that are free of foreign material which may restrict flow. Agitation of the parts may be obtained in many ways besides reciprocation of the tube. Fig. 6 shows the use of an oscillating vane as an illustration. Units of this type have been built with deliveries of as high as 1000 pieces per minute, per chute, and when built with multiple chutes and counting escapements, show tremendous production rates for packaging simply shaped objects such as pills and capsules.

Before leaving this general class of mechanisms, mention should be made of some of the more outstanding variations. Balls or pins will feed in a steady stream into a tube end, either rotated through a mass of pieces or held stationary as the pieces are rotated past. By substituting suitable rails and deflectors or combination guides and knock-offs, the principle has been successfully applied to headed, slotted or other suitably shaped work pieces. In one instance, eventual success with an extremely abrasive piece was finally achieved by using a stationary flush gate, and wiping the pieces back and forth over the gate with an oscillating paddle.

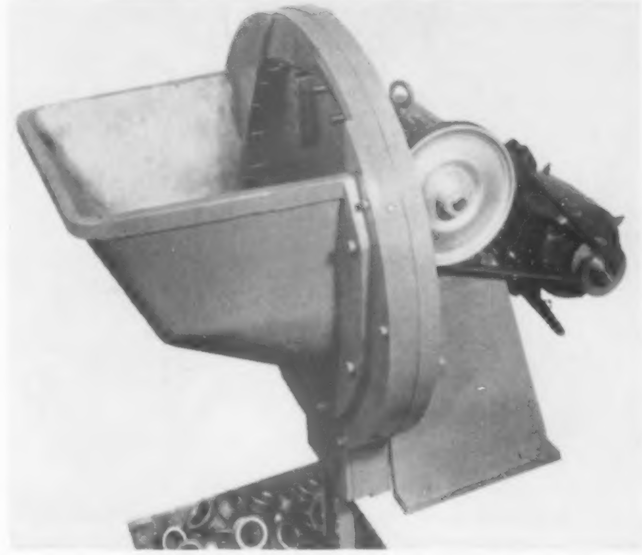
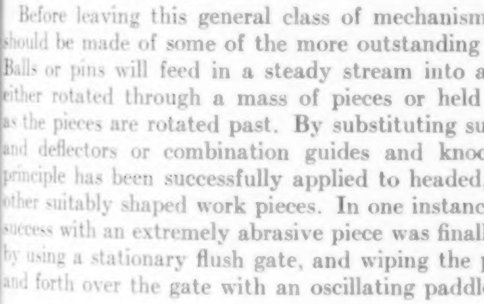
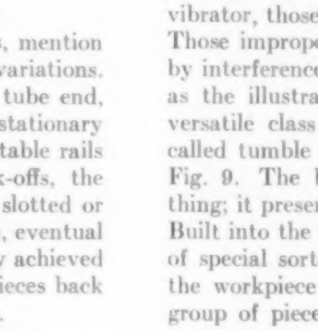


Fig. 1. Above is a simple controlled-gate, external-outlet type hopper. This type, the pin gate, may be used for orienting, depending on part complexity, and often show high delivery rates in production.

Related to the class of mechanisms just discussed is the reciprocating leaf type, illustrated in Fig. 7. The leaf in rising, either by straight line or rotation, through a load of parts, will pick up some in position to slide out of the stationary exit chute. Sometimes the leaf or leaves are stationary, and the pan with the pieces rises and falls, as in the usual type nail feeder. At present, this principle is seldom used for small parts, but is particularly adapted to relatively large, heavy pieces, especially of the headed variety. Fig. 8 shows a sketch of the so-called barrel hopper. The barrel frequently is cast with integral vanes and may be cylindrical, conical (sometimes on both ends), and may be tilted. In action, it lifts groups of parts and drops them on a rail which usually has a fairly low slope, and assisted by a vibrator, those properly positioned will slide down the chute. Those improperly positioned either fall off, or are deflected by interference points suitably attached to the chute. Crude as the illustrated device is, it has given rise to the most versatile class of feeders we have today. This is the so-called tumble type, a modern version of which is shown in Fig. 9. The base chassis of these hoppers does only one thing; it presents a controlled flow of pieces to a given point. Built into the hopper at that point have been a wide variety of special sorters or orientators whose design depends upon the workpiece requirements. Fig 10 shows a miscellaneous group of pieces for which feeders have been built recently,





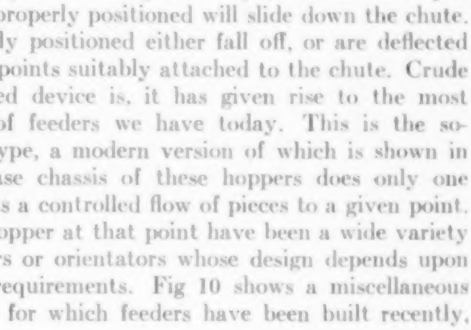


Fig. 2 (left) illustrates a gate hopper often employed for smaller parts such as eyelets. In Fig. 3 (center) is another simple feeding device used for packaging fixed numbers of parts in groups. When used for pins or odd shapes, reciprocating or vibrating motion is sometimes used with this type. Fig. 4 illustrates the pocket type, employed for continuous timed delivery of one part at a time. This type can be used for such items as small tubes and pop sticks, at a relatively high rate of delivery.

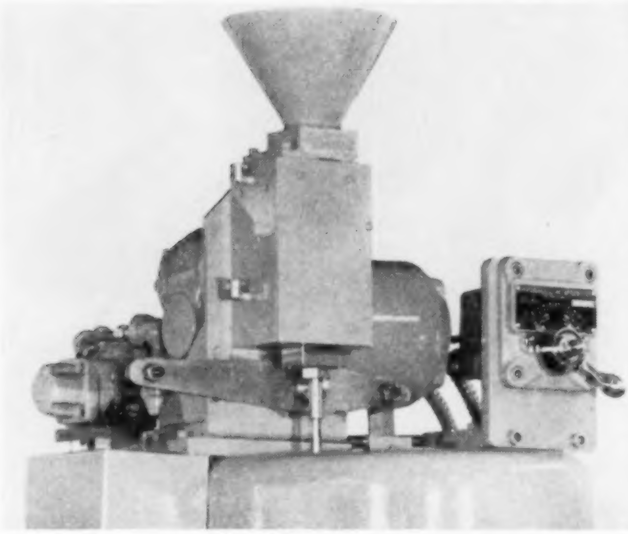


Fig. 5. The reciprocating-tube type of feed shown above is one of the oldest principles used in parts feeding. The chute, entering at the vertex of the cone, is given a vertical back-and-forth motion relative to the parts held in the container.

and the majority, including virtually all of the difficult pieces, have been handled in these tumble type hoppers. Large storage capacity is inherent; for example, a 32 in. size holds over two cubic feet of parts, by balancing the number, kind and size of the vanes, with the rotational speed of the drum, the tumble action can be made quite gentle and pieces actually pre-oriented to some extent. The chuting may range from simple winged channels or rails, to auxiliary powered and quite complex mechanisms. One feeder, for example, had four motors to drive all the necessary devices that were used. By suitable openings in the drum flange, chips and sometimes even certain defective parts can be eliminated. Vanes and areas subjected to parts impinging can be rubber covered if desirable, and chute angles can be readily changed or constructed at widely varying angles. Side, vertical or front delivery can be obtained.

Design Variations

Much can be done with vibration, particularly controlled or directional vibration. Simple dish-shaped hoppers have been built with one, or in some cases, numbers of fixed exit gates, wherein the parts have been given a rotational churning motion by vibration alone, and the feeding action was similar to the brush hoppers mentioned for eyelets. A slightly inclined chute, subjected to directional vibration, will walk pieces up an incline. This can be applied in many ways. A commercial hopper now on the market utilizes this principle to feed parts up a ramp winding around the inner periphery of a horizontally positioned drum. In this application, the entire drum is vibrated. Vibrating the chute only has advantages in some cases, as the load capacity is much greater and cross-vibration or auxiliary orientators can be added at suitable positions, without interfering with feed flow.

Prime feeders utilizing various conveyor means are very common and deserve mention, even though they are harder to classify. The inclined nest or pin conveyor principle, the horizontal conveyor with side vanes to swing parts into position, the jumps, turns and deflectors used particularly at higher speeds for eliminating double length or deformed pieces, are all common, but it is hard to say whether or not they are prime sorters, secondary orientators, or glorified chutes. They do serve, however, to lead us to a brief mentioning of some of the other classes of mechanisms necessary for complete parts handling.

A workpiece may require orientation in a number of ways. A ball requires none. A washer or straight pin needs one-way orientation. A headed piece, two ways. Flat, formed pieces may present themselves four ways and some rectangular or essentially three-dimensional pieces, may show eight or more positions. If orientation cannot be completed in the first sorter, a second or a third or even more sorters may be used. Obviously, even with the same workpiece, a number of types may be needed. Also, but not so obvious, even when no orientation problem exists, sorting means sometimes is required to eliminate faulty and extraneous pieces. Any of the sorting principles used in the hoppers discussed above can be used for secondary sorting and conversely, nearly any sorter that can be imagined, can be used in some types of hoppers for primary sorters.

Applying Feeding Mechanisms

In considering the application of these mechanisms, let us first consider a simple hypothetical case. One workpiece is manually loaded and unloaded on a machine. One operator is required for each machine, and the production rate we will assume is controlled by the operator's ability. Questions to consider are as follows: is the workpiece such that reasonably simple and practical handling equipment can be devised? How much operator attention would still be required? With fully automatic handling, how much would the production per machine be increased? With all machines in the group mechanized, how many machines could be eliminated and how many operators would be required? If it is an instance where increased production is needed, how does the cost of the handling equipment compare with the cost of additional machines that would be needed if they were hand loaded? If there are now ten machines, and by automatic handling, one man can obtain the necessary production from four machines, we obviously save the direct labor of nine men and the space and overhead of six unused machines, to offset the cost of the four installations. If the contemplated set-up is new, we not only have these savings to work with, but also the cost of the six machines saved.

Among examples picked from recent applications is the automatic feeding of a second operation into a punch press. Hand fed, the best possible production was every other revolution of the crank, as the operator had to kick the stroke on. Average production decreased to almost every third revolution. With automatic loading, the press was run on continuous cycle, with a net gain of 2-½ times production, as well as the complete elimination of operator hazard. Automatic loading of a dial-equipped, multiple-operation forming and coining press allowed only about 10 percent increase in speed, but resulted in nearly 50 percent greater

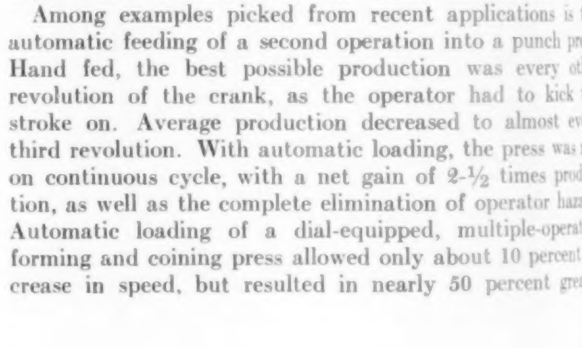


Fig. 6. Above is another application of the principle illustrated in Fig. 5. Here motion is imparted by an oscillating vane instead of tube reciprocation. Some units of this type are able to deliver as high as 1000 pieces per minute.

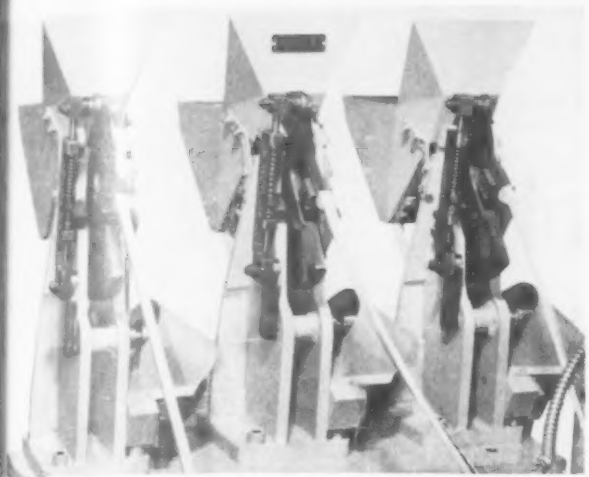


Fig. 7. In the reciprocating leaf arrangement shown above the leaf rises by straight line or rotation, and in so doing will pick up some parts which are in position. Adapted to large, heavy parts.

production due to having all nests filled. This latter result frequently occurs, and sometimes where two or more operators are all loading the same machine (a paint-spraying machine, for example) with the same part, in order to obtain the machine's potential production, both operators can be replaced with a single unit.

What this leads up to is this: with equipment and processes already in operation, definite savings can be made to amortize handling equipment, but if the installation is new, the use of handling equipment may not only result in the same savings, but may reduce the actual total investment that must be amortized.

Suppose two pieces are loaded into a machine, and unloading of the assembly in this case is automatic. There are now three possibilities. Either piece can be automatically handled. The same type of questions should now be asked for each combination. Often it happens that complete mechanization is a good thing, but often too, it will be found that there exists a law of diminishing returns, and a high percentage of gain can be obtained by retaining the operator and automatically handling only one piece. Consider the common application of driving a rivet into an assembly, which we can assume is one piece.

The production rate is much higher if the operator does not have to pick up and insert the rivet on each piece, and the rivet handling equipment is relatively inexpensive. To handle the assembly, which may be complex, may eliminate

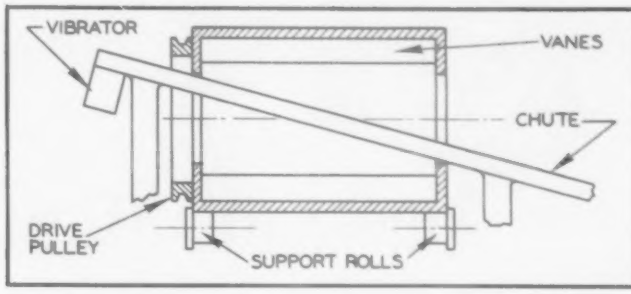


Fig. 8. The barrel hopper shown above lifts groups of parts and drops them on a rail, usually sloping, from which, assisted by a vibrator, those properly positioned will slide down a chute.

only one man and may cost too much to amortize in a reasonable time.

As the number of pieces increase, analysis becomes more involved, but the potential savings sometimes increase at a surprising rate. Consider the case where operations are performed on several machines. Can two or more of these machines be coupled together by direct transfer mechanisms or by conveyors loading into hopper equipment? Can operations be combined on one machine by adding handling equipment that now require two or even more machines, because of loading requirements? As we follow step-by-step through increasingly complicated combinations and sequences of operations, we are finally led to applications where large groups of operations are combined in single or coupled machines with savings that make large capital expenditures worthwhile. Such machines take a long time to design and build, and sometimes even a longer time to perfect. They should not be considered unless the plant personnel has experience in similar machines, and an understanding of their particular maintenance and operating characteristics.

Let us again consider the simple case of a single workpiece loaded into a machine manually. To make the case look good for automatic handling, we assumed a battery of machines and at least a doubling of production rate per machine. Assume now only one or a few machines, and no appreciable increase in final production rate. An installation of hopper and related equipment can now be amortized only by the savings of one man, and may be difficult to justify in the time management would like. Other questions should now be asked. Will this equipment build up valuable experience in the use and maintenance of such equipment? Will it help make more practical and easier, more complex applications elsewhere?

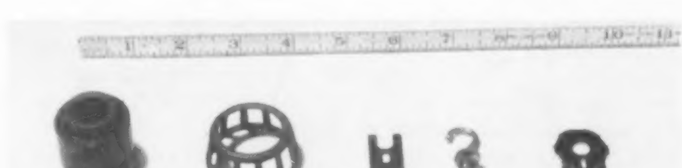


Fig. 9 (left) is an example of the principle illustrated above in Fig. 8. Known as the tumbler type, this unit is designed for the base chassis to present a controlled flow of pieces to a given point. Special sorters are available for various applications. In Fig. 10 (right) is shown a collection of widely differing products for which feeders have recently been built.

Effect of American Standards on Lathe Spindle Deflections

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THE ENGINEERING COMMITTEE on Standardization of Engine and Tool Room Lathes appointed by the National Machine Tool Builders Association, recommended in 1943 that the taper key drive spindle nose (L-type Spindle Nose) Fig. 1, and the cam lock spindle nose (D-type spindle nose) Fig. 2, be established as alternate American Standards. Although it had been hoped that one style of spindle nose might be used for all lathes, it has been found necessary again, when publishing the 1948 standards (ASA B 5.9—1948) to include both types because some engine lathe manufacturers favored type D spindle nose while others favored type L spindle nose.

The relative merits of the two alternate standards are sometimes determined on the basis of the number of parts involved in their design, cost of manufacture, ease of operation, accuracy of positioning, and other such considerations. To the author's knowledge, the investigation of the effect of standardization on the rigidity of lathe spindles has, heretofore, not been attempted.

It is therefore suggested that resistance to deformation be taken into consideration when machine tool standards are prepared because of the large effect which rigidity has on the working accuracy of the machines, their freedom from vibration and on other performance characteristics.

Accordingly, in this paper, methods will be discussed which are available for such investigations from other fields of engineering. They have been adapted to the special requirements of the tool engineer and provide information regarding deflection of the two alternate spindle nose standards. These methods do not apply to lathe spindles only, but also to other machines where workpieces must be mounted accurately and rigidly on revolving spindles.

Insofar as the American Standards do not give data required for such investigations, additional data were taken from the lathe spindle designs of the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Deflections were determined for a small spindle size and a medium spindle size of either of the two alternate standards, whereby various conditions were taken into consideration such as chucking the work and holding it between centers.

L-type and D-type Designs

Figs. 3 to 6 have been prepared for readily comparing the two alternate standards in two sizes. The upper portions (Figs. 3 and 4) show the taper key drive spindle nose (L-type) while the lower portions (Figs. 5 and 6) show the cam lock design (D-type) of corresponding size.

It will be realized from these figures that the L-type spindle nose (Figs. 1, 3 and 4) is provided with a long steep taper for supporting and centering face plates and chucks; it has a key for driving and a flanged nut for fastening face plated or chucks to the spindle.

The other standard, type D_1 spindle nose (Figs. 2, 5 and 6) is equipped with clearance holes in the outer bolt circle, each of which is provided with a cam for the purpose of engaging and locking the cam lock studs mounted in the back of the face plate or chuck.

Comparing the upper and lower portions of Figs. 3 to 6, it will also be noticed that the face plate, supported by a short taper in the case of the D-type nose considerably overhangs the spindle end. Conditions are reversed in the case of the L-type nose, where the taper is long, while the overhang is short.

Regarding the support of the centers in either design, the figures show that the center projects appreciably more beyond the spindle end in the case of the cam lock design (D-type nose) than in the taper key design (L-type nose). This difference is due to the fact that the sleeve of the D-types is not flush with the spindle end, leaving sleeve and center partially unsupported by the spindle. On the other hand, in the L-type standard, the sleeve is entirely supported by the spindle. While face plate standards have been included in the spindle nose standards ASA B 5.9-1948 chucks have not been taken into consideration. It was therefore necessary to use, for the purpose of this investigation, the dimensions of commercially available chucks. Typical chuck mountings for the L-type spindle noses will be seen from Figs. 7 and 8, while those for the cam lock designs are shown in Figs. 9 and 10, again opposite the corresponding sizes of the taper key drive spindle noses.

It will be noticed that the face of the chucks of the L-type designs has a greater distance from the front bearings, than that of the alternate cam lock designs. The dash-dotted contour lines at the back of the chucks of Figs. 7 and 8 indicate suggestions for improving the rigidity of these chucks which are unnecessarily weakened at the indicated places.

The investigations discussed here were carried out for sixteen different cases, including four types of spindle noses

namely the small and medium size taper key drive noses (L_{oo} and L_1) and the small and medium size cam-lock noses (4 in. and 6 in.). Two different load applications were considered for each of the four spindle noses, namely loads acting at the face plate and loads acting at the center. Each of these eight cases was investigated with regard to the deflection of the spindle nose only and with regard to deflection of the entire spindle.

The small size spindle noses (L_{oo} and 4 in. D_1) are used on spindles supported by two radial bearings, while the medium size spindle noses are employed on spindles with three radial bearings. These latter cases are statistically indeterminate and involve therefore a somewhat more complex procedure of analysis.

Loads and Reactions

The forces tending to bend lathe spindles are acting at the face of the face plate or at the large diameter of the center in a direction perpendicular to the spindle axis, as indicated by arrows *P* on Figs. 3 and 4.

Although gears mounted on the spindles exert like forces trying to deform the spindles, they have not been included in this analysis because they do not act at the spindle nose, but rather between the bearings. They therefore do not enter this investigation, which deals with the effect of the spindle nose standards on deflections.

It is assumed throughout this study that the load at the face plate or at the center is 1000 lb. Such a load equals the vertical (main) cutting force produced in the case of turning soft cast iron with a feed of 0.004 in./rev and a depth of cut of 0.25 in. A load of 1000 lb is therefore a relatively small load which may often be exceeded in practice; it has been adopted for the present discussion because it permits calculation of deflections at other loads in a convenient way. Deflections of spindles made of steel increase substantially, proportional to the increase in the applied load.

In the investigations covering the deformation of the entire spindles, the width of the bearings has been simplified to a narrow support giving concentrated reaction forces. This permits also a comparison of the edge pressure at the bearings and of the angle of inclination of the elastic curve with the undeformed spindle axis. Since the design of the spindle left from the front bearing is optional, the L-type and D-type spindles have the same dimensions between front and rear bearings.

In the studies covering the deformation of the spindle nose only, it has been assumed that the front bearing is set tight and thus fixes the spindle rigidly there.

Fig. 1. Lathe headstock equipped with taper key drive spindle nose.
Fig. 2. Lathe headstock equipped with cam lock spindle nose.

Differences lie in the axial distances from the front bearings to the face of the face plate and to the large diameter of the center, and also in the diameters and moments of inertia of the spindle noses.

Deflection of the Entire Spindle Under Loads Acting at the Face Plate

The distances from the front bearing to the face of the face plate are respectively 3.75 in. for the L_{oo} spindle nose and 4.30 in. for the 4 in. D_1 type spindle nose. In the case of the L_1 type design, this dimension is 6 in., as against 6.23 in. for the 6 in. D_1 type spindle nose.

The overhang of the face plate beyond the spindle end is about ten times greater for the cam lock standard (4 in. D_1 type) than for the alternate taper key drive standard (L_{oo}), namely 1.20 in. as against 0.125 in. and about eight times greater for the 6 in. D_1 type spindle nose (1.94 in.) than for the alternate L-type design (0.25 in.).

Computation of the deflections of the entire spindle requires the determination of the moments of inertia for the various spindle diameters and also adjustments of the moment curve, resulting from the load, in accordance with the various spindle diameters.

In the case of the medium size spindles, the investigation must be extended to include the elimination of statically indeterminate conditions resulting from the three bearing support.

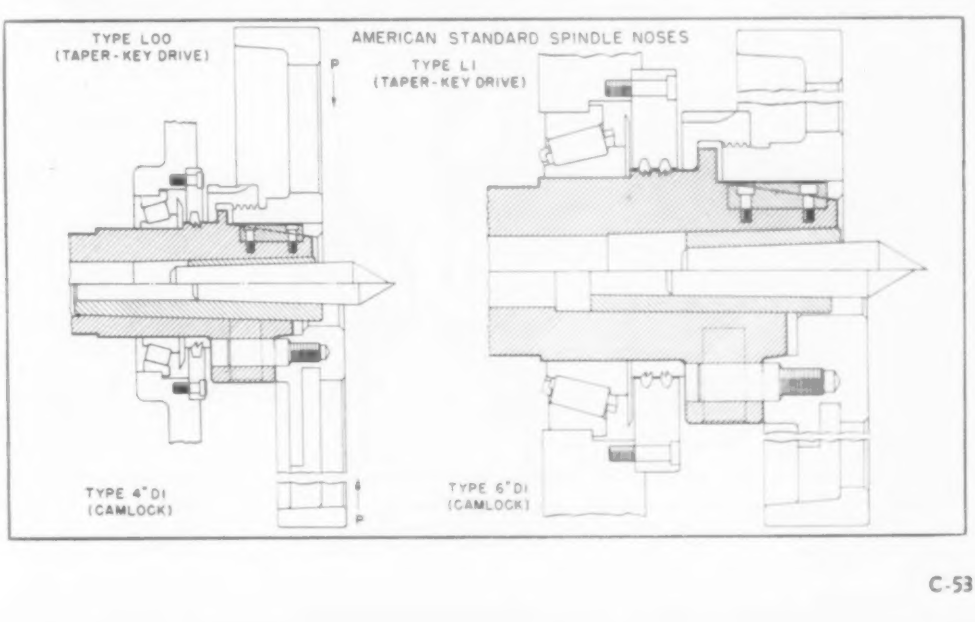


Fig. 3. Section through Type LOO American Standard Spindle Nose (taper key drive). (Top left).

Fig. 4. Section through type LI American Standard Spindle Nose (taper key drive). (Top right).

Fig. 5. Section through 4 in. Type DI American Standard Spindle Nose (cam lock). (Bottom left).

Fig. 6. Section through 6 in. Type DI American Standard Spindle Nose (cam lock). (Bottom right).

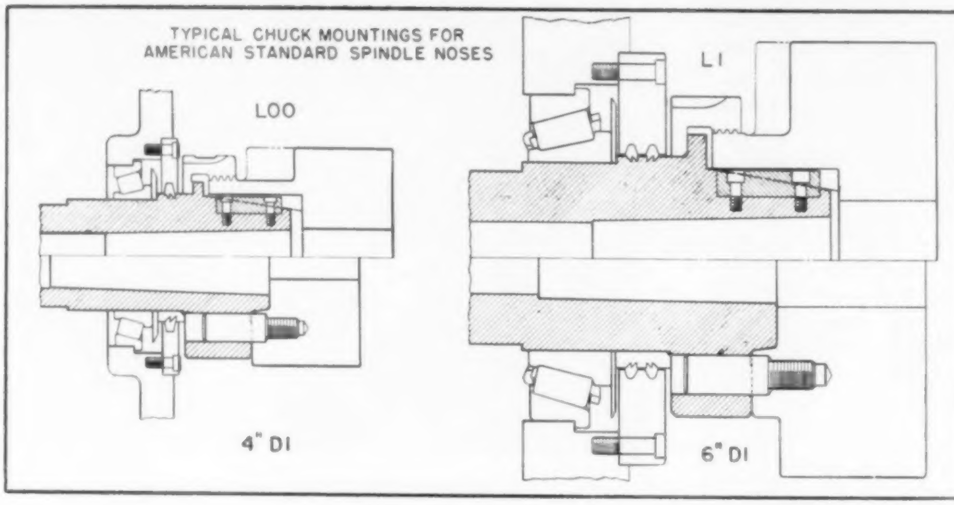


Fig. 7. Typical chuck mounting for Type Loo American Standard Spindle Nose.

Fig. 8. Typical chuck mounting for Type L1 American Standard Spindle Nose.

Fig. 9. Typical chuck mounting for Type 4 in. D1 American Standard Spindle Nose.

Fig. 10. Typical chuck mounting for Type 6 in. D1 American Standard Spindle Nose.

Small Size Spindles (Two Radial Bearings)

Lengthy derivations for these conditions shall not, however, be included in this presentation and reference is taken instead to Figs. 7 and 8, showing the graphical analysis of the two small size standards (L_{oo} and 4 in. D_1 respectively).

It will be seen that the deflection of the cam lock design 4 in. D_1 is 0.0023 in. per 100 lb applied load as against 0.00185 in. per 1000 lb applied load for the alternate taper key drive standard (L_{oo}). Under these circumstances, the cam lock design deflects 24 percent more than the taper key drive design.

The reactions at the front bearings were found to be: 1270 lb for the L_{oo}, and 1310 lb for the 4 in. D_1 standard when a load of 1000 lb is applied at the face plate. At the rear bearings the comparative reactions were: 270 lb for the L_{oo} and 310 lb for the 4 in. D_1 standard per 1000 lb.

The angle of inclination of the elastic line with respect to the undeformed spindle axis beyond the front bearing can be computed from the straight portion of the elastic line. It is 1.92 min for the cam lock standard and 1.70 min for the taper key design L_{oo}. If the front bearings are set tightly, therefore, the edge pressure in the case of the cam lock design will be accordingly higher than for the L_{oo} design.

The straight portion of the elastic line is due to the stiffening effect of the face plate; that is, its large moment of inertia in comparison with the rest of the spindle.

Medium Size Spindles (Three Bearing Support)

The results of the analysis of the deflection of the two alternate medium size spindle designs (L_1 and 6 in. D_1) are shown on Fig. 9. Two elastic curves had to be determined for either standard in order to find the load at the center bearing and to eliminate the statically indeterminate condition of the three bearing design.

For the first elastic curve, the center bearing was disregarded and the deflection determined as if the spindle were supported only by the front and rear bearings. The elastic curves for this case are shown bent upwardly on Fig. 9 between the front and rear bearing and bent in the opposite direction at the face plate.

To determine the second elastic curve, the effect of the center bearing was introduced as a force required for eliminating the deflection at the center bearing, the magnitude of which is indicated by the first elastic curve. A "counter deflection" of the entire spindle is produced in this way and indicated by the lower curves. The resultants of the two

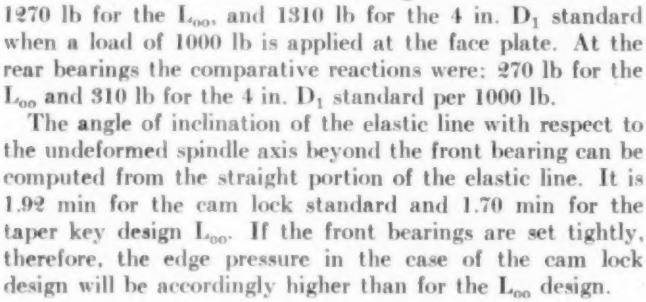


Fig. 11. Deflection diagram for Loo spindle, with two radial bearings.

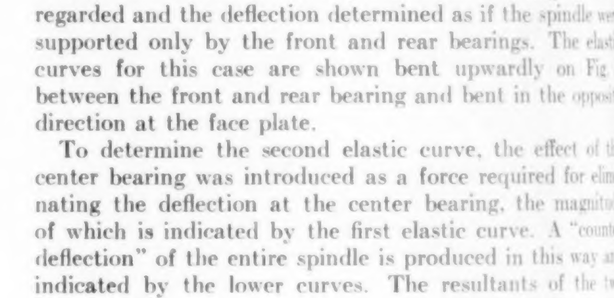


Fig. 12. Deflection diagram for 4 in. D1 Spindle, with two radial bearings.

astic curves for each design represent the actual deflection curves passing through all three bearings.

The center bearing has the effect of reducing the deflection at the face plate by 45 percent, namely from 0.0035 in. to 0.0019 in. in the case of the L_1 type spindle and from 0.0038 in. to 0.0021 in. per 1000 lb load for the 6 in. D_1 type design. The resultant deflection of the cam lock design is therefore 11 percent greater than that of the taper key design in the case of the medium size spindles with three radial bearings.

The load at the center bearing is 790 lb for the L_1-design and 820 lb for the 6 in. D_1 design per 1000 lb load applied at the face plate. The reaction at the front bearing is 1560 lb for the L_1 type and 1580 for the 6 in. D_1 type per 1000 lb applied load. When the load is applied at the face of the chuck, rather than at the face of the face plate, the relationship between the deflections of the entire spindles of the two alternate designs is reversed. Under these circumstances, the small size spindle with cam lock nose deflects 25 percent less and the medium size spindle 9 percent less than the corresponding taper key drive spindles.

Deflections of Entire Spindle Under Loads Acting at the Center

The deflections of the entire spindle when the load is applied at the center has been determined by the graphical methods corresponding to those shown in Figs. 7 and 8 for loads at the face plate. In the case of the small type—(L_{00}) design, the deflection was found to be 0.0027 in. per 1000 lb load for the 4 in. D_1 standard; the latter deflects therefore 15 percent more than the taper kiy drive design.

Deflections under loads acting at the centers in the case of the three bearing designs (L_1 and 6 in. D_1 types) were estimated, assuming that they would be somewhat larger than the face plate deflections of the three bearing designs.

Deflections of Spindle Nose Only

The preceding calculations are based on the reduction of the bearings to narrow supports, permitting a pivoting of the spindles within the bearings. The following investigations are based on the opposite assumption, namely that no deflection occurs within the bearing. This is equivalent to stating that the spindle nose is fixed at the front bearing and that all deformations take place outside the front bearing. The possibility of rotation of the spindle is, of course, not affected by this assumption.

Under these circumstances the spindle nose represents a shaft with various diameters, fixed at one end and loaded at the other one by a force acting at 90 deg to its longitudinal axis. Mathematical formulas give better information in these cases than the graphical methods employed previously. However, the practice of basing the calculation of deflection on the smallest diameter only is not recommended.

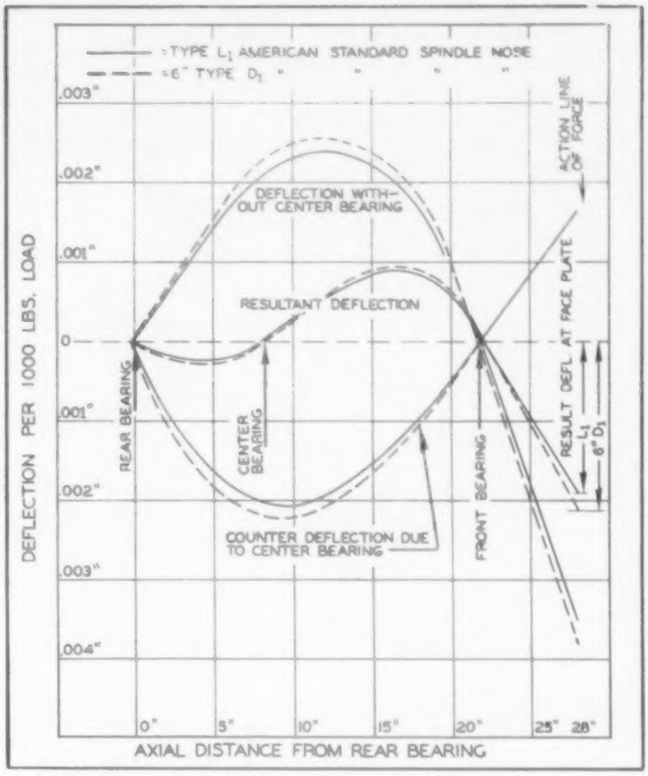
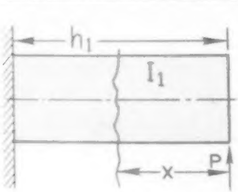


Fig. 13. Elastic curves of lathe spindles supports by three bearings (L1 type and 6 in. D1 type spindle noses).

FIG. 14. DERIVATION OF FORMULA FOR SPINDLE NOSE DEFLECTION



FIRST DIAMETER

Applying the fundamental equation *) to this case and using:

$$M_1 = P.x \quad ; \quad \frac{\delta M_1}{\delta P} = x \text{ , with}$$

the limits of the integral between 0 and h_1 results in

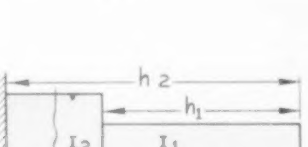
$$f_1 = \frac{P}{E.I_1} \int_0^{h_1} x^2 \ dx = \frac{P}{3.E.I_1} \cdot h_1^3 \qquad (1$$

Applying the fundamental equation *) to the second diameter and using:

$$M_1 = P.x \quad ; \quad \frac{\delta M_1}{\delta P} = x \text{ with}$$

the limits of the integral between h_1 and h_2 results in:

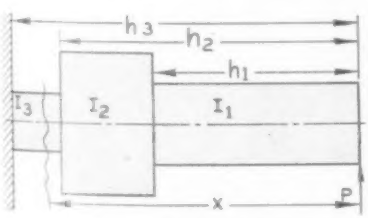
$$f_2 = \frac{P}{E. \ I_2} \int_{h_1}^{h_2} x^2 .dx = \frac{P(h_2^3 - h_1^3)}{3.E.I_2} \qquad (2$$



SECOND DIAMETER

In the same way, using limits of the integral between h_2 and h_3:

$$f_3 = \frac{P(h_3^3 - h_2^3)}{3. \ E.I_3} \qquad (3$$



THIRD DIAMETER

*)Fundamental equation for displacement of a point located on an elastic body loaded by force P:

$$f = \int \frac{M_1}{E.I.} \cdot \frac{\delta M_1}{\delta P} \ dx$$

where: f = deflection, M_1 = moment acting in section; I = moment of inertia of section; E = modulus of elasticity; x = distance of considered section from load P.

Total deflection $F = f_1 + f_2 + f_3 + \ldots$

Hence:

$$F = \frac{P}{3 \ E} \left(\frac{h_1^3}{I_1} + \frac{h_2^3 - h_1^3}{I_2} + \frac{h_3^3 - h_2^3}{I_3} + \ldots\ldots \right)$$

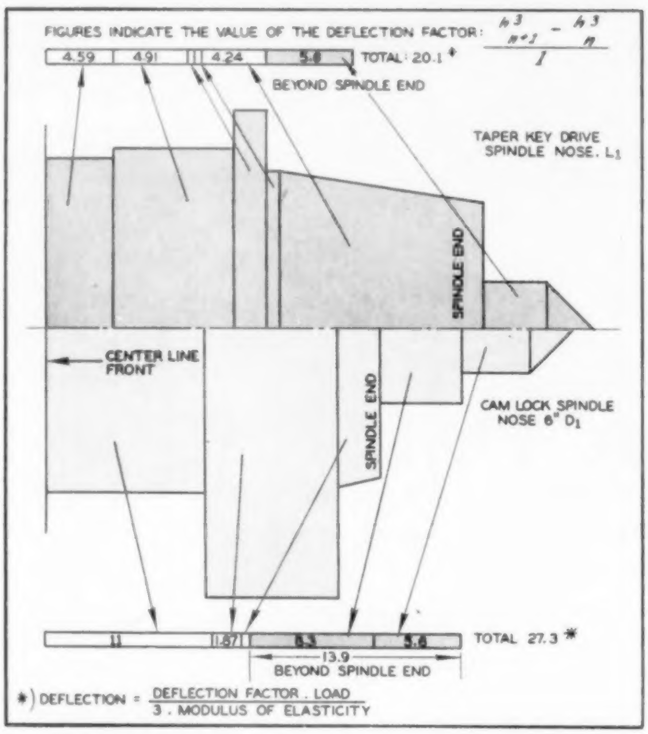


Fig. 15. Itemized deflections of L1 type and 6 in. D1 type spindle noses when considered fixed at the front bearing and with load applied to center.

It was necessary to adapt formulas not generally used, to the present conditions; they were found very useful for determining deflections of stepped shafts, fixed at one end. These equations are based on the fundamental formula for the displacement of a point located in the action line of a force on an elastic body. Details will be seen from Fig. 10, winding up with an equation which takes into account the deflection of each individual section of the shaft. This individual deflection is represented by a factor which involves the cubes of the distances from the force and the fourth power of the diameters as moments of inertia.

With the aid of this equation it is possible to evaluate the contribution which each section makes to the total deflection of the shaft.

Reference is taken to Fig. 11 showing the itemized deflections of the medium type spindle noses (L_1 and 6 in. D_1) when fixed at the front bearing and with loads applied at the center. The upper portion of Fig. 11 refers to the L_1-type spindle nose, the lower one to the 6 in. D_1-type nose. The value of the deflection of each section of the spindle nose is graphically shown above and below the two sketches.

As an example, it will be noticed that the deflection factor for the center (at the right hand end) is the same for both spindle standards, namely 5.6. The taper of the L_1 type standard has a deflection factor of 4.23, while the sleeve of the 6 in. D_1 type standard has a factor of 8.3. The total deflection factor for the taper key drive standard L_1 is 20.1 as against 31.5 for the alternate 6 in. D_1 design. Since the deflections are directly proportional to these factors, it follows that the deflection of the cam lock design 6 in. D_1 is 20 percent greater than that of the taper key drive design L_1. The actual value of the deflection is obtained by multiplying the factors by the following constant:

$$\frac{\text{Load}}{3 \times \text{Modulus of Elasticity}}$$

It is also interesting to note that the portion projecting beyond the spindle end on Fig. 11 deflects appreciably more in the case of the 6 in. D_1 design (factor 13.9) than in the case of the L_1 type design (factor 5.6). In this portion, therefore, the cam lock design 6 in. D_1 deflects approximately 15 percent more than the taper key drive design L_1.

The deflections for the various other cases where the spindle is considered fixed at the front bearing have been computed in the same way as indicated on Fig. 11. When the load is applied at the face of the chuck and the spindle is fixed at the front bearing, the deflection of the small size cam lock design (4 in. D_1) is 4 percent less than that of the alternate L_{00} design. In the case of the medium size designs, however, the advantage lies with the taper key drive spindle nose, since cam lock spindle nose (6 in. D_1) deflects 16 percent more when the load is applied at the chuck than the L_1 type design under the same circumstances.

It is evident that the distance of the load from the front bearing is not a sufficient criterion for comparing deflections; it is rather necessary to consider also the diameters of the bearings and of the spindle nose with respect to their distance from the load as indicated by the Fig. 14.

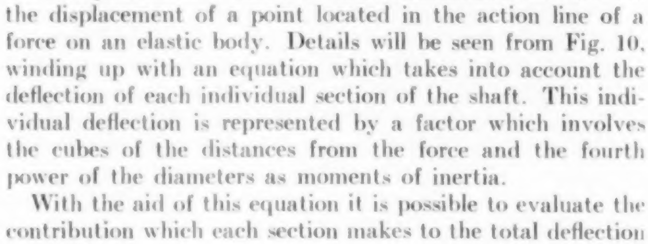


Fig. 16. Synoptical deflection diagram for small size lathes.

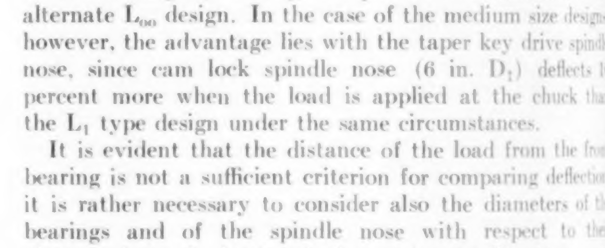


Fig. 17. Synoptical deflection diagram for medium size lathes.

Automation in the Press Room

By Herman F. Zorn
PRESIDENT
THE V & O PRESS COMPANY

A press is the fastest production tool known to man. This high production tool can be made still more productive by automation—automatic devices such as roll, dial, bar, and grip feeds; transfer motions; hoppers; in addition to practical safety devices to protect the machine and its tools.

Roll Feeds

Roll feeds are probably the most commonly used automatic feeding devices applied to presses. They are available in either the single or double types and in all sizes from very small ones for feeding material around 0.0005 in. thick and of a very narrow width to those that feed material wide enough to make tops for automobiles. They are applicable to machines that operate at speeds of 2 to 3 strokes per minute and having several thousand tons capacity; to presses operating at speeds up to approximately 1000 strokes per minute and having 2 or 3 tons pressure capacity. Roll feeds are mounted on almost every conceivable place on the press.

When and Where to Use a Single or Double Roll Feed

A single roll feed is used to especial advantage when a part is made and completed without leaving a skeleton; that is, the material is fed through the roll feed to the die, and the part is completed without leaving any scrap to be carried on after the finished piece is cut off. It usually works out to advantage, however, to use a double roll feed. In the latter application when material is started into the die, one feed will move the material through the die until it reaches the other feed. At this point the feeds operate simultaneously until the end of the strip is reached. The second feed then continues until the strip is completely fed. Double roll feeds, of course, are necessary on thinner materials to prevent buckling.

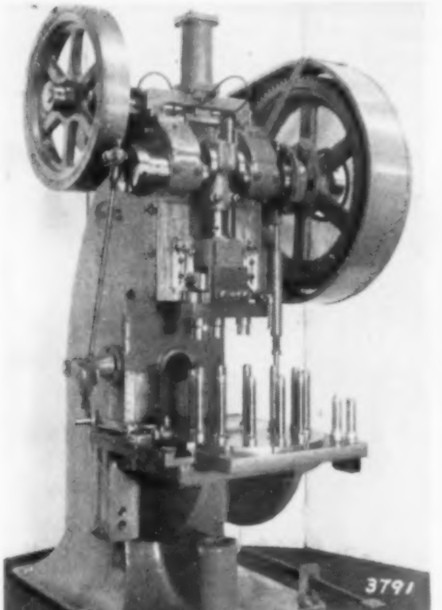
The accuracy at which roll feeds will operate is a problem which constantly confronts the manufacturer of feeds. In the final analysis a roll feed is not a measuring machine. Even though roll feeds are made to a high degree of precision and will feed accurately on short, flat strips, inaccuracies must be expected on the general run of materials. A variation in the thickness of the material (particularly sidewise), rough edges (especially sheared stock), and short kinks affect the gripping of the rolls, causing inaccuracies. When coiled material is used and the roll feed unreels the coil, unless the tension between the coiled stock and the roll feed is constant, the roll feed catches up with a taut piece of material and a jerk takes place on the coil. This, of course, affects the length of feed at that particular moment. With these factors taken into consideration, it is advisable whenever possible to feed against a stop—that is, a positive stop or finger stop. If the design of the part is such that it will not permit a positive or finger stop, pilots should be used. When pilots are employed the upper roll should be released, permitting the material to float so that when the pilot pin goes into the pilot hole the material is free to move. This permits centering of the blank or, material, correcting the possibilities of errors outlined above.

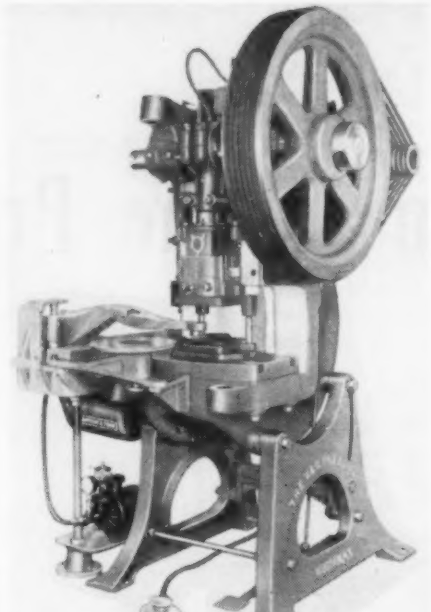
Roll feeds in general operate with very little attention, enabling an operator to oversee several machines.

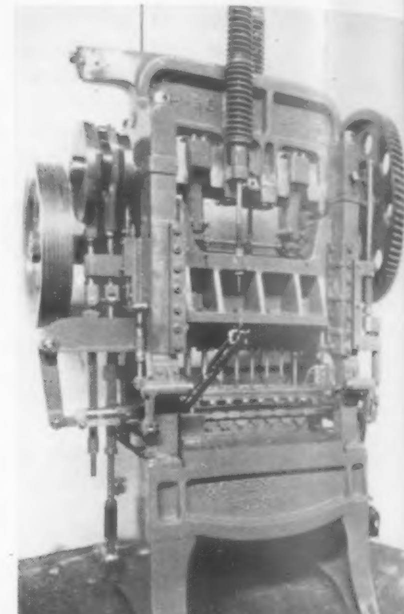
Grip or Slide Feeds

Grip or slide feeds employ an anvil as a lower member and a gripping finger as a top member which results in a biting action on the stock and propels it in its path to the tools. A positive stop at each end of the sliding member accurately controls its movement.

In conjunction with roll, grip, or slide feeds stock straighteners are recommended to eliminate curvature in the material. Scrap cutters are also recommended for chopping the scrap or skeleton material after it leaves the press.







(Left) This ring type dial feed with dies mounted on the dial is complete with automatic safety stop. The application is on a horning and wiring press. (Center) A combination of double bar feeds, chute feeds, transfer motion and automatic safety stop is applied on this press. (Right) A mechanical hand is seen in operation on this press, set up to lift stampings from the die.

Dial Feeds

While roll, grip, or slide feeds are used for primary operations, dial feeds are invariably used for secondary operations.

Dial feeds in general are circular conveyors, moving parts to the die or dies. At times dies are mounted directly on the dial plate and are carried to the various punches mounted on the press slide. There are four outstanding types (ring, disc, continuous friction, and intermittent friction). The ring type, the most prominent, lends itself to the greatest variety of work. As the name indicates, it consists of a ring having station holes or pockets to carry the work, which roates around a center plate mounted either directly on a special bolster or on a dial base. It is operated by an indexing pawl and locked in position by a locking pawl.

The disc type is similar in operation except that it rotates around a shaft instead of a center plate. The dial plate rotates continuously on the continuous friction type, carrying parts on its surface by friction rather than in pockets. It is driven from the press shaft by belts or gears. The intermittent friction driven type is propelled by a friction band instead of an indexing pawl.

The number of operations that can be performed on a part with the use of a dial depends greatly on the design of the part. It is quite common to perform from one to ten or twelve consecutive operations. However, when a number of operations are performed at one time it is quite necessary to have a well-supported and well-guided flanged slide on the press, as many of the operations take place quite a distance from the center of the slide. The limiting factor when a number of operations are combined is that it is necessary to maintain an outside dimension of the workpiece through all of the operations, since each station in the dial plate has the same shape. Many different jobs can be made on the same dial feed by changing the dial plate for various sized pieces. At times interchangeable bushings can be used in the dial plate, thereby saving expenses and facilitating set-up time.

Dial feeds, when used in conjunction with presses, are employed primarily to speed up production. In addition, they provide safety to the operator, as he performs his duty away from a point of danger. Thus, as soon as the operator realizes this protection he assumes a rhythm which is conducive to his capabilities. This point can best be reached by varying the speed of the machine. It works well to start such equipment at a slow rate of speed, stepping it up gradually until the most efficient tempo for the operator is reached.

Many jobs offer possibilities of being blanked on the same machine with the dial. With some of these it is also possible to perform several operations in a progressive step die prior to blanking and feeding into the dial. This can be done only when a ring-type dial feed is used, as it is necessary for the die to bridge the dial plate. After the piece is blanked and dropped into the dial, it is carried around for the various subsequent operations.

In many cases it is practical to convey component pieces to the part that is being operated on, making it possible to assemble as well as perform individual operations.

Oftentimes these component parts can be made on the same machine, feeding the material with the use of a roll feed and making the part either in a progressive step or single die. The last station of the die is directly over the dial plate, so the finished part drops into position in the dial. Component parts can be made in another machine and transferred by means of a conveyor belt and fed into the dial feed by a transfer motion. Also, extra parts can be fed by hoppers, magazines or chute feed, making an expensive and complicated assembly comparatively simple and inexpensive. Dials lend themselves particularly well to hand-fed assembly operations. In many instances where several parts are to be assembled, the dial feed is of a large diameter, permitting room for a number of operators to work around its circumference and so arranged that each operator can feed a respective piece in position progressively at the proper station. Usually the last operator, or the one who feeds the final part in position, also acts as an inspector to see that the parts are completely assembled. In addition, he

control of the press and can stop it or let it continue. The speed at which dials operate depends largely on the skill of the operators who feed them. Dials can be operated either in a clockwise or counterclockwise direction, depending on what works out best for the particular job. It is essential in performing multiple operations in a dial to have the press slide equipped with cam knockouts. Thus, after the operations are performed and as the slide moves up, the parts which are of such shape as to stick to the punch will be ejected from the punches at the proper time, leaving them in the dial plate to be conveyed to the next position. On some jobs it is also necessary to have the machine equipped with cam knockouts in the bed which will eject the pieces from the dies into position in the dial before it starts to move to the next position. After all operations are performed, the part or parts are ejected through or from the dial into a chute, to a tote box or to a conveyor which carries the parts away.

Safety Stop Design

For proper die protection an automatic positive safety stop should be employed. The automatic positive safety stop can be either a mechanical or electrical device. When a mechanical device is used it is best to operate it from the press shaft by a cam so arranged that after the dial has come to rest the cam permits a pin to drop into a hole in the dial plate. As long as everything is functioning properly this pin drops into position and the press continues to operate. In the event of a jam or if for any reason the dial does not register in its proper location, this pin rests on top of the dial plate, placing a lever in the path of the clutch release ring. This withdraws the clutch dog from the flywheel and the press stops before the punches come in contact with the work or the dial plate, thus preventing any breakage of punches or dies. As soon as the obstacle is removed and the dial again located in its proper position, the pin drops in the hole on the dial plate and permits the machine to continue its operation. The automatic safety stop should be so arranged that the press will stop at each stroke unless the dial is in its final registered position.

Quite often on dial feeds, in conjunction with the automatic positive stop, a solenoid is used to trip the machine. With the solenoid it is possible to use limit switches at different positions in the dial so that in the event of improper registration or on jobs where an assembly of parts is made, if a piece is missed or the component part is not fed, the limit switches automatically cut off the solenoid. This in turn shuts off the machine, eliminating the possibility of the machine continuing to assemble parts that are not complete.

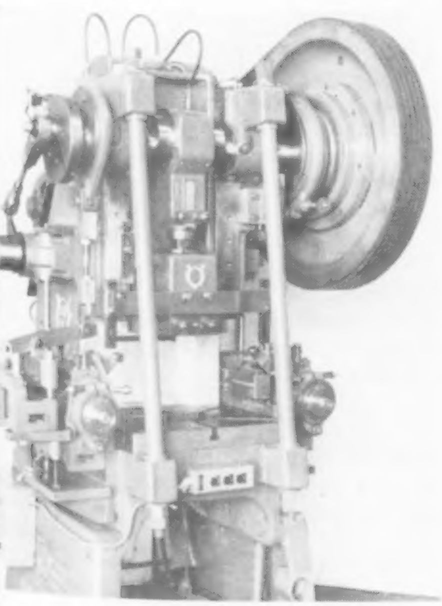
A number of advantages may be gained from attachment of an inspection plunger or plug to the positive safety stop operating shaft. For example, if a shell during certain operations must pass through the machine with the open end up, the inspection pad or plug working in conjunction with the safety stop drops into the shell. If not for any reason the shell is upside down or contains foreign matter, the plug cannot enter and this in turn alerts the safety stop and automatically shuts off the machine.

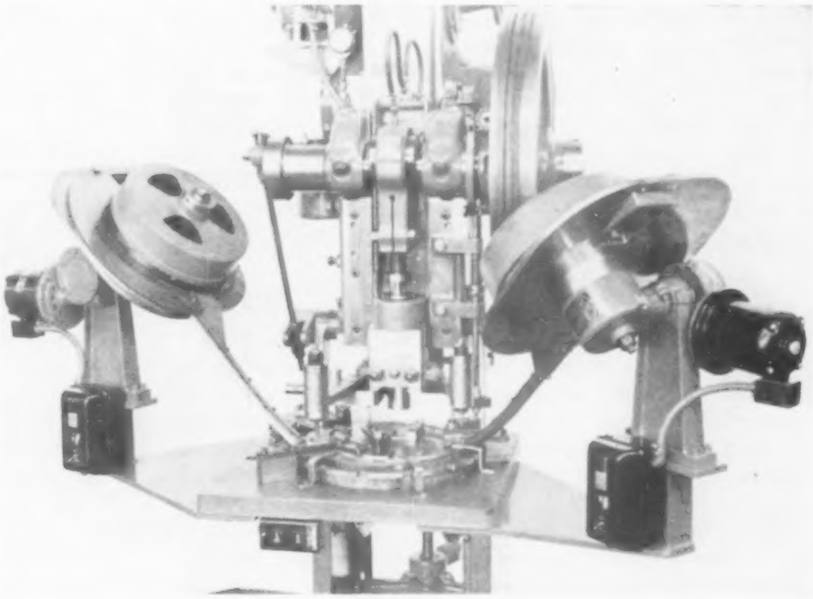
The accessibility of an inclinable-type press is the reason for the adaptation of dial feeds to a much greater degree than with other types of presses, although in a number of cases dial feeds are used with considerable success on straight side, horning, punching, knuckle joint and other types of presses.

Bar Feeds

Bar feeds are not as commonly used as roll, grip, or dial feeds. However, they have a definite place and fill a need that cannot be taken care of as effectively with other types of feeding mechanisms. They lend themselves particularly to the carrying or transferring of parts that require a number of operations, parts which change their shape considerably after each operation, and parts which cannot be carried along in the material, either because of their shape or from the standpoint of economy of the metal.

Bar feeds fall into two general types. One is a reciprocating, rectangular bar that is moved back and forth over the dies (guided in ways) by means of a cam on the press shaft and connecting levers, the movement or motion of the bar being from front to back. This type works particularly well





(Left) Double adjustable roll feeds and scrap cutter are appplied to this inclinable press. (Right) Two individually-driven hopper feeds are working in conjunction with a dial feed on this inclinable press. Setup involves hoppers, magazines, transfer motion.

with inclinable presses. However, in order to use this type of feed, the press must be equipped with many special features. It should be fitted with a cam knockout in the slide which can be set to strip the parts from the punches at the proper time in the cycle in order to leave them in the dies. The press also should be equipped with a lower slide (cam actuated) accurately guided in ways, to which can be attached a series of knockout pins or pads that will eject the parts from the dies into the path of the bar at the proper time in the cycle.

A roll or grip feed is generally used (in conjunction with the bar feed) to feed coiled or strip material, from which the blank is taken. After the blank has been taken out a scrap cutter is used to chop the skeleton. Where a bar feed is used on subsequent operations, a chute or magazine with a transfer motion is used to place the part into position in the bar.

All features must be set and timed very accurately so that all will coordinate and make an effective, smooth operating unit. The sequence of operations is as follows: The press is tripped, the slide descends and performs the first operation. As the slide moves up, the cam knockout in the slide operates, leaving the part in the die. Then the bar moves forward and the lower slide moves up, ejecting the part from the die into the bar. The bar moves back, transferring the part to the next station, placing it in the gages or set edges of the second die ready for the next operation. The part continues on until all operations are completed, at which time the finished part is ejected from the bar. After that, each stroke of the press produces a finished part. The number of operations that can be performed on a part varies considerably but three to eight operations are common.

This type of bar feed can be applied to small bench presses or the largest of inclinables.

The double bar feed is generally employed in connection with straight side presses. It consists of a double bar which functions from left to right or right to left of the press from cams on the crankshaft. These bars, in addition to having a motion right to left or vice versa, have a motion in and out and work in conjunction with fingers that are attached to them, moving the part progressively from the first to the last station. The method in which they function is as follows: after the part has been blanked and the first operation performed on it, the cam knockout in the slide strips the part from the punch, leaving it in the die. Then a cam knockout in the bed knocks the part out and into the path of the bar feed. The bar feed moves together, gripping the part on the circumference or periphery; then the bars move the part along laterally to the next position and holds it there until the slide descends and the punch contacts the part. Simultaneously the bars move out, leaving the punches and dies free from any fingers or other obstacles. The bars then move laterally to their original position and are again ready to repeat the cycle.

The double bar feed is commonly used when larger parts are processed, necessarily making it a slower operating feed than the other type described. If desired, a roll or grip feed can be employed at the first station to feed the material for blanking. The skeleton material can be chopped with a scrap cutter. If the parts can be made more economically, from a material standpoint; by being blanked, or blanked and drawn in multiples in a separate machine, they can be fed by means of hopper, chute, or magazine feed and transfer motion to the bar feed.

Regardless of which type of bar feed is used, an automatic positive safety stop is necessary to insure proper positioning and locating of the bars and parts in order to avoid jams or die breakage.

The "Mechanical Hand"

The "mechanical hand" incorporates fingers or a vacuum cup, and automatically feeds parts from a nesting plate to a standard punch press. As the mechanical hand returns for the next piece it automatically trips the press and the finished part is ejected by air from the die.

The mechanism is provided with safety control which prevents tripping of the press unless the blank is correctly placed in the die. Longer die life results because the mechanical hand places the blank accurately.

The operator, whose hand is never under the punch or in danger, is not tired at the end of a day's work for it overcomes completely the fear of hand feeding and the strain of foot tripping.

The device is applicable to all sizes of inclinable presses as well as straight side, knuckle joint, and other types.

Industrial Applications of Metamics

By W. O. Sweeny
HAYNES STELLITE DIVISION
UNION CARBIDE AND CARBON CORPORATION

Metal ceramics are a new product made by powder metallurgy techniques, and consisting of a combination of metals and ceramics. These materials have been given various names, such as ceramels, cermets, and cermetallic. Those of our company's manufacture are trade-marked "Metamic". All of the information contained in this paper is based on the work done by Linde Air Products Company and the Haynes Stellite Division, Union Carbide and Carbon Corporation, Kokomo, Indiana.

Metal-ceramics are produced by four different techniques:

1. Slip casting, which is an ancient ceramic technique wherein fine powder constituents are suspended in a water slurry or slip. The mixture is poured into a porous plaster mold from which it can later be removed, dried and fired. This is the same production process that is used to make bath tubs and toilet bowls.
2. Cold pressing, followed by firing.
3. Hot pressing, wherein the pressure and firing temperatures are produced simultaneously in a graphite die. This is the same manufacturing procedure used for hot pressing of sintered tungsten carbide.
4. Extrusion, followed by firing.

Practically all the articles we have made have been slip cast.

Most of the work which we have done on metal-ceramics, both in producing the pieces and in evaluation tests, has been carried out using a grade designed as LT-1. LT-1 is made up of chromium metal and alumina. Some limited work has been done on a grade designated as LT-2 in which the metal phase is complex and the ceramic phase is again alumina. There are many other compositions which have been prepared in the Laboratory, but the following comments will apply exclusively to Metamic LT-1.

Properties

Physical and mechanical properties are shown in Table I.

Appearance—Metamic LT-1 is dull gray or green in the as-fired condition, but when ground or machined has a typical metallic appearance.

When Metamic LT-1 fails under stress, the fracture is completely non-ductile except at extremely high temperatures or under prolonged stresses at high temperatures. However, the fracture appears finely crystalline and metallic.

Brittleness and Impact Strength

While Metamic LT-1 is strong, it is also brittle and chances are fifty-fifty an LT-1 part would break if it should be dropped, for example, on a concrete floor. Its impact strength at room temperatures is much less than metals, but about double that of pure ceramics.

Thermal Shock Sensitivity

The Properties Bulletin, which we have been using on Metamic LT-1, states that the material is thermal shock-sensitive in the sense that a small Metamic article is apt to crack if heated rapidly or unevenly. This has been a cautious approach in the belief that people who are testing Metamic LT-1 should proceed carefully. Actually, while we do not recommend it, many of the people who have tested Metamic LT-1 have heated it to a dull red and plunged it into water without cracking. Others have heated it to a temperature in the range of 2800 to 3000 deg F and have cooled it with a blast of cold air without cracking. For the most part, the shapes involved in these qualitative tests have been rather simple, and had the pieces been more complex, there is a greater likelihood they would have failed from thermal shock. We still believe that it is advisable to consider Metamic as a thermal shock-sensitive material in comparison with metals. However, when comparing it with ceramics it can be considered a thermal shock-resistant metal.

Strength

Most of the properties available on strength of Metamic are expressed in terms of bend strength (modulus of rupture) as in the ceramic industry, since, originally it was felt that Metamic specimens would be too brittle to obtain reproducible tension test results. However, recently, standard Metamic type specimens were machined and short-time tensile tests made. The values of Metamic at room and elevated temperatures on bend strength and tensile tests at elevated temperatures are shown in Tables I and II. A comparison of tensile strength of Metamic LT-1 with the best commercial high temperature alloys available is shown in Fig. 2.

Oxidation Resistance

As in the case of thermal shock sensitivity the Properties Bulletin on Metamic LT-1 has been quite conservative regarding oxidation resistance in that it has shown a figure of 2200 deg F as the top temperature at which Metamic LT-1 is resistant to excessive oxidation in air. One manufacturer has tested Metamic LT-1 at 2800 deg F for two 12-hour periods. While there was considerable surface oxidation, it was not enough to cause deterioration of the part structurally.

Another manufacturer has subjected Metamic LT-1 to 3000 deg F gas temperature for a period of ½ hour. In this case it was estimated that the temperature of the specimen was only 2400 deg F, but there was no evidence of surface oxidation. We believe the method for determining whether Metamic LT-1 is suitable for a specific application is to test it under actual operating conditions and for a sufficient period of time to establish its oxidation resistance for the specific service conditions

Resistance to Molten Metals

Metamic LT-1 has been successfully submerged in molten carbon and stainless steels, molten brass and bronze and various nickel bronzes. In all of these cases it successfully withstood the corrosion except when oxygen was injected into the molten steel. Apparently, it is rapidly attacked by the superheated iron oxide vapor. Also, it is rapidly attacked by certain molten glasses and alkaline vapors at high temperatures, and preliminary tests indicate that it is not satisfactory for molten aluminum.

Thermal Conductivity and Electrical Resistivity

The thermal conductivity of Metamic LT-1, as shown in Table 1, is comparable with cast iron and is three to four times better than the highly alloyed high temperature metals. This property makes it particularly attractive for quick thermocouple readings and also accounts in part for its thermal shock resistance. The electrical resistivity is 87 microhm per cm at 70 deg F, which is somewhat less than the highly alloyed metals.

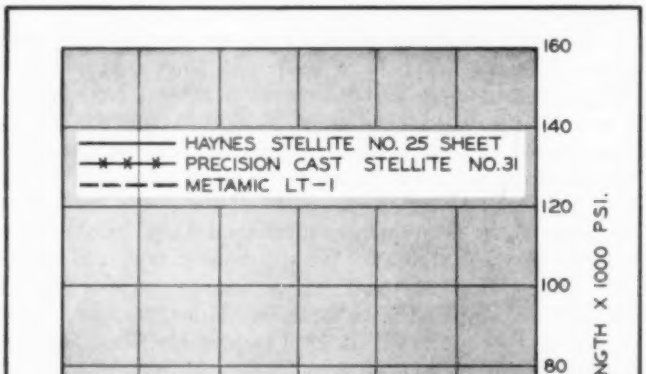


Fig. 1. Typical microstructure of Metamic LT-1.

Size and Shape Limitations

At present there are no production facilities for making Metamic parts nor is there any real manufacturing experience in producing intricate shapes or large quantities of simple shapes. These factors are responsible for the meager amount of information and knowledge we have of the material and make the limitations for it more narrow than might be expected when production facilities and manufacturing experience are obtained. The information gained to date has been from parts made on a laboratory scale. A pilot plant is now being set up to continue the development work.

Certain restrictions are imposed because Metamic metal-ceramics cannot be worked by metal-processing operations such as rolling, forging and drawing as conventionally understood. Also, a certain amount of warpage is inherent in the Metamic production process. Extended fabricating methods wili ease these restrictions in the future, but currently, the following represents the limit of what may be expected in a Metamic article.

Maximum sizes

With present equipment, pieces up to 2-inches diam x 18-in. long can be produced, or 3-in. diam. x 3-in. long.

Long-thin articles

It is desirable to stay below a length-to-diameter ratio of 30 for rods and tubes, and under a length-to-thickness ratio of 30 for flat, plate-like articles, for example:

Rod: 0.1 in. OD x 3 in. long
Rod: 0.6 in. OD x 18 in. long
Tube: 0.5 in. OD x 0.25 in. ID x 15 in. long

In the case of thin-wall tubes it is desirable to stay under a diameter-to-wall thickness ratio of 8, such as:

Sleeve: 3 in. OD x 3 in. long x ⅜ in. wall
Tube: 1 in. OD x 12 in. long x ⅛ in. wall

Regardless of other dimensions, it is at present difficult to produce articles having a wall thickness under $\frac{1}{16}$ in.

Complex shapes

It is possible to produce very intricate shapes by the use of cores and multi-piece molds. However, the usual care should be taken to avoid sharp corners without fillets as in a flange. In some cases, complex shapes are produced by machining soft pre-fired blanks, followed by finish-firing to achieve final hardness and strength.

Distortion

Camber in as-produced straight pieces sometimes amounts to $\frac{1}{16}$ in. in a length of 8 in., or $\frac{3}{16}$ in. in a length of 18 in. In the case of circular sections, the as-produced pieces may be oval in cross section to the extent of the minor diameter being less than the major diameter by 5 percent. On plane surfaces, warpage or curling to the extent of $\frac{1}{16}$ in. in 3 inches is to be expected at present. Closer tolerances may be handled by producing the parts slightly oversize and finish grinding or machining.

Uniform Wall Sections

The inside diameter of tubes must usually be produced by coring, and a taper of 0.002 in. (on the diameter) per inch of length must be allowed for core withdrawal. Also, it is not always possible to insure that cores are precisely centered. Where an application requires unusual precision in those respects, the matter should be brought to the manufacturer's attention.

Tolerances

Metamic articles are produced with a nominal accuracy of plus or minus 2 percent on the principal linear dimensions, except where this accuracy is obviated by the limitations given above regarding warpage and slightly nonuniform wall thicknesses. Where a large number of identical pieces are to be produced, closer tolerances can be held.

Specifications on Purchase Orders

The best way to handle the above unavoidable deviations from geometric trueness is usually to describe in some detail the application requirements. For example:

"The Metamic thermocouple tube must slide through a 1.000 in. ID hole, 11 in. long; and thermocouple beads 0.370 in. OD x 1.25 in. long must slide to the bottom of the Metamic tube."

A dimensioned sketch of the pertinent surroundings of the proposed application is always helpful in obtaining the lowest possible cost quotations.

It should also be borne in mind that Metamic can be readily machined or ground so stock should be specified on surfaces requiring close dimensional tolerances.

Joining

Although techniques have not been developed for fusion welding Metamic metal-ceramic articles to themselves or to steels or alloys, a number of joining techniques are available:

1. Mechanical threaded joints.
2. Metamic bolts and screws can be made on special order. These are, however, relatively brittle and therefore unsuited to shock loading or stress concentrations.
3. Metamic can readily be pressure-welded to Metamic by standard oxy-acetylene techniques or with high frequency induction heating. As in the pressure welding of steel, a slight "upsetting" of the joint is desirable. Jigging for pressure welding must be done more carefully than for steel articles in order to avoid excessive stress concentration since Metamic is non-ductile. However, small, simple pieces can often be pressure-welded in a bench vise with a hand welding blowpipe.
4. Shrink fitted joints can be designed for fairly heavy stresses.
5. Metamic can be copper-brazed to steel by conventional hydrogen-furnace procedures. Metamic is not readily wetted by silver solder.
6. Complex shapes can in some cases be produced by joining subassemblies during the original Metamic fabrication process in the factory.

Machining

Metamic LT-1 can be machined readily with tungsten carbide tools, or where tungsten carbide tools are not available, high speed steel tools may be used by reducing speeds, feeds, and depths of cut.

Facing, turning, and boring Metamic LT-1, using tungsten carbide tools, is best accomplished at a speed of 60 to 65 sfpm and a feed of 0.004 ipr. Heavier feeds are likely to cause breakage and force the tool to dig into the work.

Threads smaller than ¼ in. should be ground on Metamic LT-1, but larger diameters can be either ground or machined.

Holes less than ¼ in. diameter should not be tapped, but holes of larger diameters can be either ground or machined. Center drilling is readily performed by standard procedures.

Milling Metamic LT-1 with high speed steel cutters has been best accomplished at a speed of 50 sfpm and a ½ in. feed per minute. At present, there are no milling data available based on milling this material with tungsten carbide cutters, but there seems no reason this cannot be successfully carried out.

Using a shaper, Metamic LT-1 can be machined with tungsten carbide tools at approximately 12 sfpm and 0.010 in. feed per stroke. With high speed steel tools, the speed and feed should be cut in half. There is a tendency on the part of this material to chip slightly at the end of each stroke.

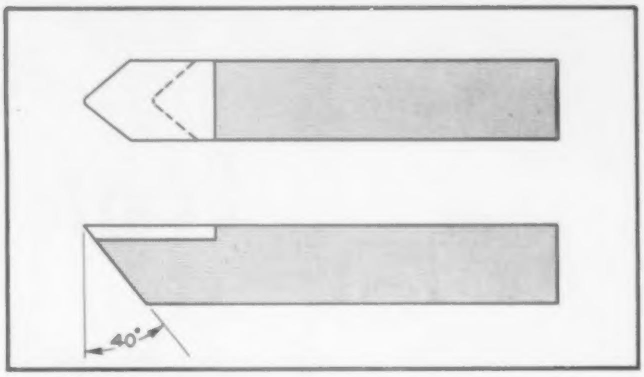


Fig. 2. Comparison of tensile strength of Metamic LT-1 and commercial high temperature alloys.

Grinding procedures to follow in grinding Metamic LT-1 are the same as those recommended for the conventional grinding of high speed steel using the soft grade, open structure vitrified bond aluminum oxide abrasive wheels. Wherever possible a coolant should be used.

Metamic LT-1 can be cut with a soft grade rubber bond, aluminum oxide abrasive cut-off wheel using a coolant. The thickness of the cut-off wheel should be held to the minimum, depending on the type of machine and the size of cut.

The type of general purpose tool we have found to work best is shown in Fig. 3. Plenty of clearance is needed for free cutting and the top face of the tool should be 90 deg with the work. Various machining operations that may be carried out on Metamic are shown in Fig. 4.

Metamic LT-1 has been tested for several industrial applications and has shown promise of strength, resistance to oxidation at elevated temperatures and of thermal shock. Thermocouple protection tubes have been tested by immersion in molten steel, cast iron, brass, bronze and other metals, except aluminum and frequently have shown up well on test, both in increased life and quicker readings because of better thermal conductivity as compared to high temperature alloys and ceramic tubes. As many as twenty immersions have been experienced without evidence of corrosion from the molten metals.

Likewise, promising results have been obtained by the insertion of Metamic tubes in molten stainless steel for bubling argon gas into the bath and into carbon steel for bubbling nitrogen. The Metamic has been able to withstand the thermal shock of going from room temperature to approximately 2800 to 3000 deg F and has been unattacked by either the molten slag or molten metal.

Flame electrodes for controls have been tested in various gaseous atmospheres and have withstood the oxidizing temperatures under these conditions in a temperature range of 2400 to 2800 deg F. These flame electrodes depend upon electrical conductivity and at the temperatures involved most metals are molten and ceramics, because of their poor electrical conductivity and thermal shock sensitivity are not suitable for this application.

Metamic has been tested in several parts of ram jets, including the Venturi-type nozzle, the flame holders and thermocouple tubes. Temperatures for these applications have been around 3000 deg F gas temperature.

Metamic is being tested for turbo-supercharger blades by the N.A.C.A. These blades are still in the process of manufacture, but the physical properties themselves look attractive enough to justify engine testing. Likewise, both production and experimental gas turbine Metamic nozzles are being fabricated. These nozzles will not only permit higher gas temperatures, but are also devoid of strategic alloying elements.

Design Economics

By John Van Hammersveld
SUPERVISOR OF DESIGN COST CONTROL
THE GLENN L. MARTIN COMPANY

DESIGN PROGRESSION USUALLY follows a general pattern of evolution to develop a product. Functional design aspects are the first consideration to determine the working relationships of the various parts and concepts of originations. Next, and directly aligned with the functional design, is the investigation of material requirements, specifications and costs to meet structural integrity. Following these progressions the phases of design and manufacturing producibility are surveyed in relation to the contract quantity. Finally, the incorporation of tooling requirements, types and procedures aligned with manufacturing methods are achieved.

This sequence shows the specific design breakdown portraying the relationship of each stage. In other words, this implies that design evolution is a complete cycle, all points being united together as one basic problem. To maintain design and manufacturing efficiency in today's competitive market, it is essential that the complete *design progression* cycle be recognized and fulfilled.

Examination of the functional aspects of design indicates that these are inherent qualities that a designer possesses from his natural aptitude for engineering and his educational background. However, the aspects of design and manufacturing producibility are not inherent but are phases of design that need constant investigation, development and application since these are the basic fundamentals for achieving low cost products.

Now the question arises, "What can be done to provide the engineer with the tools (used in a broad sense) necessary to achieve maximum efficiency in design evolution?"

The Glenn L. Martin Company has been actively engaged for a number of years in a development program to find ways and means to effectively step up the efficiency of designing to acquire economical production in a similar manner as the manufacturing personnel has always been supplied with the most efficient tooling procedures, process techniques, and equipment.

One of the first steps in this effort to provide the tools was the development of design information in bulletin form; a basic function of the Design Cost Control Group. This information is prepared in a concise form to quickly supply the engineers with the most pertinent design economics. There are three basic types of bulletin information: Comparative Cost of Materials, Comparative Cost of Standard Parts, and Design for Economy.

Comparative Cost of Materials

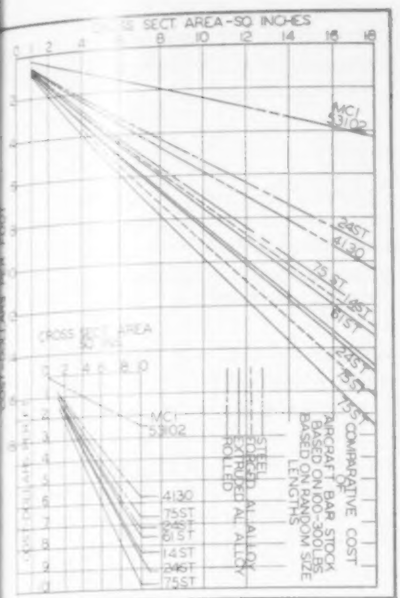
This bulletin contains cost data on all metallic materials used in the fabrication of parts. It covers a range of material types such as: bar stock, tubing, extrusions, castings and forgings, in all commonly used alloys of aluminum, steel and magnesium.

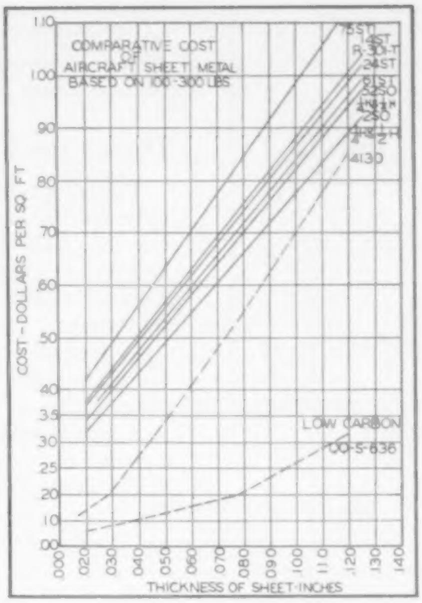
All material cost data are shown in useful graphical form to facilitate the ease of obtaining and show the engineer the comparative costs of each kind of material under each basic type. For bar stock, sheet metal, aircraft tubing and aluminum extrusion (Figs. 1, 2 and 3) a premise of 100-300 lb. is established as the normal purchased quantity of material to show the comparative cost relationships. From statistical material pricing data the curve plots are evaluated using the most feasible methods of presentation such as: for bar stock, cross-section area vs. cost per linear foot; sheet metal, gage thickness versus cost per square foot; tubing, diameter and wall thickness vs. cost per linear foot. Extrusion costs are estimated on a cost per pound basis.

The exact cost per pound can be easily interpolated by developing the correct form factor for the desired extruded shape which is the cross-section perimeter divided by the cross-sectional area multiplied by 1.2. This factor, when applied to the current price table, gives the basic cost per pound. Also included is the die cost information which is based on the size of the circle which will circumscribe the cress section of the extrusion in question.

The forging and casting cost data (Figs. 4, 5, 6 and 7) required considerable investigation and development to achieve comparable bases of presentation. A classification premise as shown in Fig. 8 evolved into definitions of simple, average and complicated classes to provide the engineer with an efficient means of obtaining accurate cost data for his selections. Also, a quantity premise of 100 pieces, established as a maximum purchase quantity, set the bases for the development of the curve plots.

To obtain the statistical data for the development of the curves, a card index file system coordinated with the purchase order receipts provided a continuous flow of up-to-date cost information. Fig. 9 illustrates a typical type file card and purchase order showing the breakdown of the cost data. Also, a file drawing of each part is maintained and used for classifying as well as obtaining weight information for the X ordinate in plotting the curves.





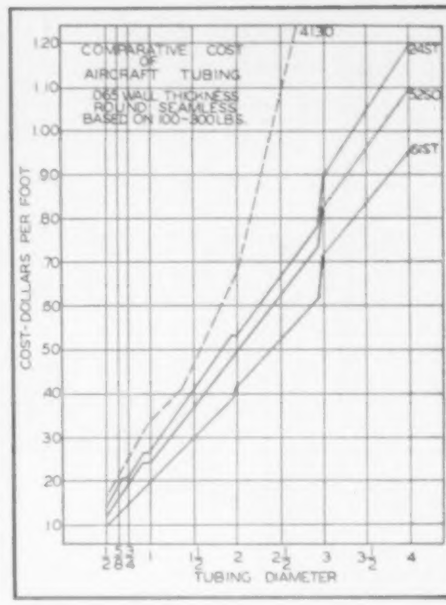


Fig. 1. (left) Aircraft bar stock material cost. Fig. 2. (center). Aircraft sheetmetal material cost. Fig. 3. (right). Extrusion material cost.

The use of the weight bases to determine the per-piece prices and pattern or forging die cost proved to be very effective since the drawings of the parts are released with the estimated weights. This is a procedure prevalent in the aircraft industry.

The engineer in the early stages of design is often confronted with the problem of when and when not to specify a new extrusion and die; reorder an existing extrusion; use standard stocked extrusion and machined off legs, or produce the shaped part from machined bar stock.

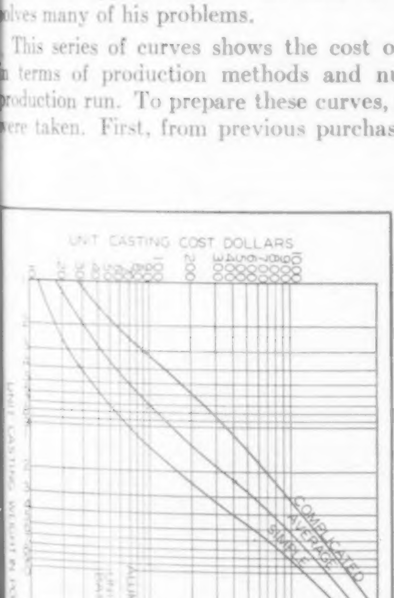
Extruded material is widely used in aircraft design because of its excellent structural applications and ease of fabrication. To aid the engineer in determining the proper decision, a typical set of cost data as shown in Fig. 10 solves many of his problems.

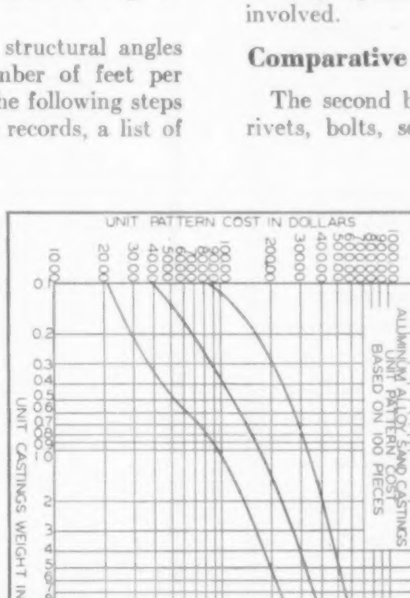
This series of curves shows the cost of structural angles in terms of production methods and number of feet per production run. To prepare these curves, the following steps were taken. First, from previous purchase records, a list of frequently used angles was drawn up. By listing angle dimensions it is found that, by grouping, they fall into various diameter-circumscribed circles. Second, by selecting the average size within the circle diameter, the basis for determining comparative production costs can be developed. As indicated in Fig. 10 crossover points show when certain methods of extrusion procedures pay for themselves, depending upon the quantity required.

Material cost data given in the bulletin can be used easily. After the designer has established a satisfactory functional design, he determines the amount of material needed to manufacture the design. Using the material cost tables and charts, he selects the most economical material to use, depending on his judgment of the design factors involved.

Comparative Costs of Standard Parts

The second bulletin lists cost of standard parts such as: rivets, bolts, screws, and fasteners. Almost every manu-





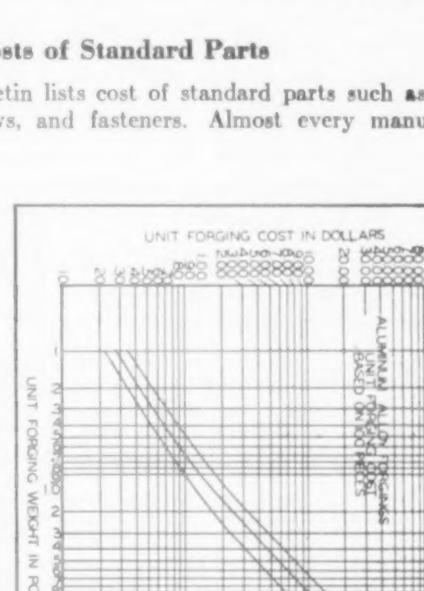


Fig. 4. (left) Unit casting material cost. Fig. 5. (center). Unit pattern cost. Fig. 6. (right). Unit forging die cost

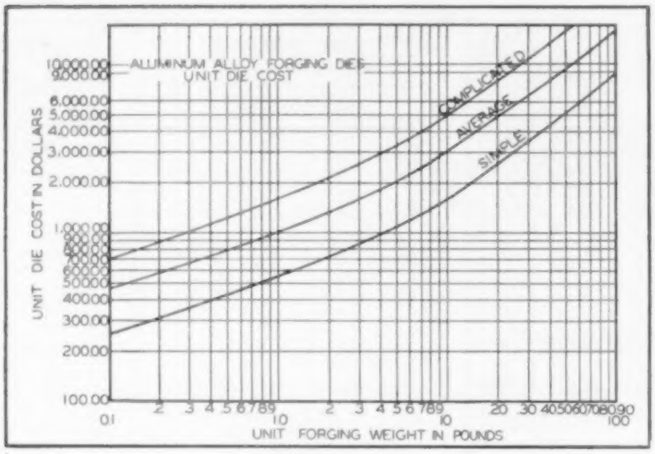


Fig. 7. Unit forging material cost.

facturing company uses standard parts in the fabrication of a product and, of these, there are many sizes and types. Usually the installed cost of a standard part, rather than the initial cost, determines whether or not it can be used. To facilitate presenting this information for the engineer's use, it is organized into two main divisions:

Part 1—Installed cost of standard parts used in the general applications of structural designs.

Part 2—Installed cost of standard parts used in general applications of nonstructural designs.

All standard parts are listed by their specific commercial or AN standard name, number, size, length, grip, weight and installed cost. In the total cost are the cost of the part, the labor cost for handling, drilling, reaming, countersinking, dimpling, riveting, de-burring, tightening, checking by operator, and all other operations required to complete the installations.

The time to perform each operation is evaluated from standard time data and converted to dollar costs by applying proper fatigue allowances, take-away rates, learning cycle curve factors and overhead rates. The material cost for each standard part is based on general bulk shipment normally procured by the Purchasing Department for a number of production orders.

Comparing the cost of similar standard parts, as shown for a typical page in Fig. 11, the designer is able to select the most economical standard which meets design requirements. His selection sets the cost of installation. Shown in

FIG. 8—CLASSIFICATION OF PROCESSES

CASTINGS

SIMPLE: (1) Impression in one half of the mold. (2) No coring.

AVERAGE: (1) Impression in one half of the mold plus simple coring. (2) Impression in both halves but no coring.

COMPLICATED: (1) Impression in both halves of the mold plus intricate coring.

NOTE: In quantities of less than 100 pieces the pattern equipment is usually "loose wood" of pine or mahogany material and runs approximately 40 to 60 percent of permanent metal equipment.

FORGINGS

SIMPLE: (1) Impression in one half of the die. (2) Parting planes are straight.

AVERAGE: (1) Impression in both halves with straight forward die sinking. (2) Parting planes are straight.

COMPLICATED: (1) Impression in both halves of the die plus complicated or curved die faces of wrapped parting planes. (2) Deep impression to fill. (3) Multiple blocking dies necessary.

GENERAL NOTES: Die costs remain constant for any quantity of pieces. The unit price is subject to change for low quantities. Die setup charges approximately 10 percent of die cost.

this bulletin are installed cost data for Hi-shear rivets compared with bolts, blind rivets compared with regular type Airloc fasteners compared with anchor nuts, and many other combinations of standard parts.

Design for Economy

The Design for Economy bulletin is comprised of over classified fitting summary sheets as typically shown in Fig. 12. This type of presentation shows the designer the aspects of manufacturing and tooling cost on the type of material selection for the quantity of fittings under consideration.

As a series of historical references of fitting designs, these summary sheets are of great value to the designer. Using these references for comparing similar shape, size and weight to a newly-designed fitting will enable the designer to make a design decision with a fair degree of accuracy.

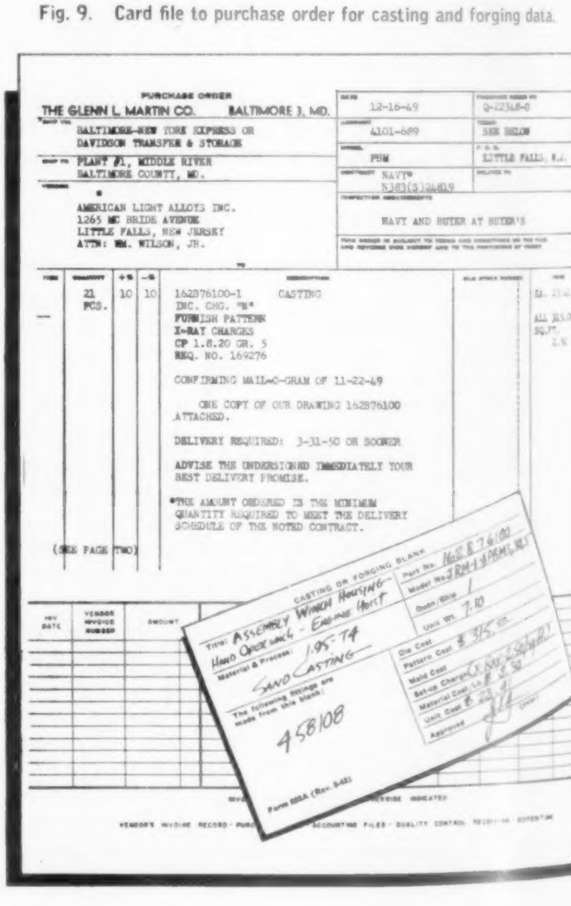
The procedure followed in obtaining the data itemized in Fig. 12 is typical of the coordinated efforts of the designer and Design Cost Control engineer in reaching the correct decision. Four methods of fabricating this fitting are analyzed to determine the most economical method of manufacture for the types of material selected: (1) 24S-T machined bar stock, (2) 14S-T machined forging, (3) 4130 welded steel, and (4) machined aluminum alloy casting.

Premise is set for a quantity of 100 parts, with shop lot releases set at 25 parts. This premise, as in any cost investigation, is of vital importance since the quantity of parts to be made has a direct bearing on the method of manufacturing.

In Fig. 13 is shown the breakdown of costs of material, fixed tools, set-up labor, dies and patterns to fabricate the fitting by each of the four methods being studied.

The first step in the analysis is to develop material costs. The unit material and forging die or pattern costs for each application is readily obtained from the charts in the bul-

Fig. 9. Card file to purchase order for casting and forging data.



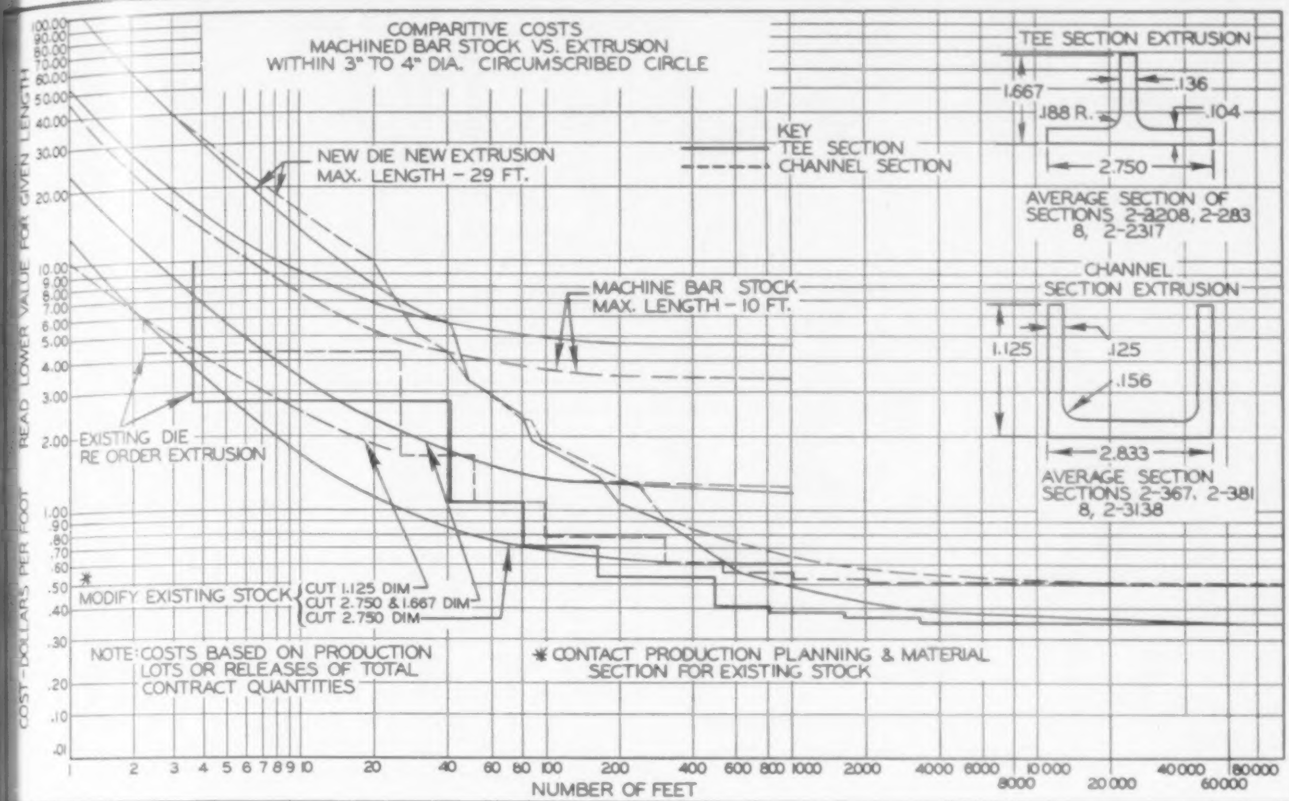


Fig. 10. Comparative extrusion and machined bar stock costs.

tin "Comparative Costs of Material" as shown in Figs. 1, 2, 4, 5, 6, 7 and 8.

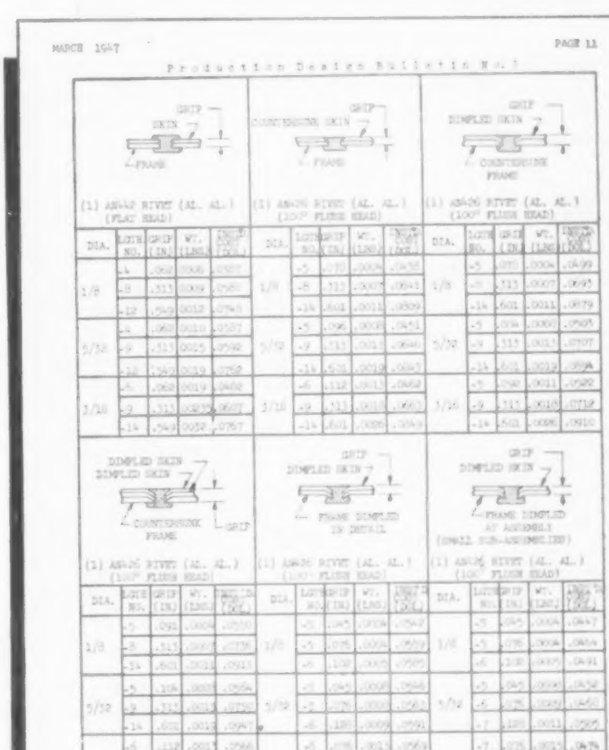
The next step in the analysis is to develop the manufacturing cost by means of an elemental breakdown of setup and labor time in machining or fabricating each design (Fig. 13). To develop these elemental breakdowns requires an experienced man who knows all types of machines in the shop as well as the techniques used in producing a part from these machines. The design cost control engineer in the various projects has the knowledge and techniques to analyze these fittings as to their elemental breakdown.

The time value for each operation is evaluated from standard data books compiled by the cost control group. Adding the elemental time values for both setup and run-time establishes the total operation time sequence. Normally this total in minutes is changed to hour values for conversion to dollar-costs.

The evaluation of the dollar-cost conversion factor requires the incorporation of cost accounting data for rework and rejection allowances, direct labor immediate supervision adjustment factor, and average departmental efficiency percentage. Then by applying the average direct labor rate and burden percentage, the complete dollar-hour conversion factor is evolved. This figure, when multiplied by the amortized setup and total run times in hours, will give the final dollar-cost of fabrication.

After the material and fabrication cost of each fitting is determined, the next step is the consideration of the tooling cost to complete the total cost evaluation. The fixed tools necessary to complete the fabrication are composed of a prick-punch template for locating the attachment holes, and a welding fixture. All four fitting designs require the prick-punch template with only the welded design requiring the additional welding fixture. The type of tools and manufacturing hours to build them are coordinated with the Class "A" casting, since this casting is classified as a structural fit-

Fig. 11. Standard parts—rivet cost comparisons.


MARCH 1947 PAGE 11

Production Design Bulletin No. 1

(1) AN442 RIVET (AL. AL.) (FLAT HEAD) | (1) AN426 RIVET (AL. AL.) (100° FLUSH HEAD) | (1) AN426 RIVET (AL. AL.) (100° FLUSH HEAD)

DIA.	LGTH. NO.	GRIP (IN.)	WT. (LBS.)	UNIT COST (DOL.)	DIA.	LGTH. NO.	GRIP (IN.)	WT. (LBS.)	UNIT COST (DOL.)	DIA.	LGTH. NO.	GRIP (IN.)	WT. (LBS.)	UNIT COST (DOL.)
1/8	-4	.062	.0006	.0507	1/8	-5	.070	.0004	.0435	1/8	-5	.070	.0004	.0499
	-8	.313	.0009	.0580		-8	.313	.0007	.0641		-9	.313	.0007	.0693
	-12	.549	.0012	.0745		-14	.601	.0011	.0809		-14	.601	.0011	.0879
5/32	-4	.062	.0010	.0537	5/32	-5	.096	.0008	.0451	5/32	-5	.094	.0008	.0505
	-9	.313	.0015	.0592		-9	.313	.0013	.0646		-9	.313	.0013	.0707
	-12	.549	.0019	.0752		-14	.601	.0019	.0663		-14	.601	.0019	.0894
3/16	-5	.062	.0019	.0602	3/16	-6	.112	.0013	.0462	3/16	-5	.090	.0011	.0522
	-9	.313	.0023	.0607		-9	.313	.0018	.0661		-9	.313	.0016	.0712
	-14	.549	.0052	.0767		-14	.601	.0026	.0649		-14	.601	.0026	.0910

(1) AN426 RIVET (AL. AL.) (100° FLUSH HEAD) | (1) AN426 RIVET (AL. AL.) (100° FLUSH HEAD) | (1) AN426 RIVET (AL. AL.) (100° FLUSH HEAD)

DIA.	LGTH. NO.	GRIP (IN.)	WT. (LBS.)	UNIT COST (DOL.)	DIA.	LGTH. NO.	GRIP (IN.)	WT. (LBS.)	UNIT COST (DOL.)	DIA.	LGTH. NO.	GRIP (IN.)	WT. (LBS.)	UNIT COST (DOL.)
1/8	-5	.092	.0004	.0550	1/8	-5	.045	.0004	.0547	1/8	-5	.045	.0004	.0447
	-8	.313	.0007	.0735		-5	.075	.0004	.0559		-5	.075	.0004	.0464
	-14	.601	.0012	.0913		-6	.102	.0005	.0585		-6	.102	.0005	.0491
5/32	-5	.104	.0008	.0564	5/32	-5	.045	.0008	.0546	5/32	-5	.045	.0008	.0452
	-9	.313	.0013	.0750		-5	.075	.0008	.0562		-6	.075	.0009	.0460
	-14	.601	.0019	.0947		-6	.102	.0009	.0581		-7	.125	.0011	.0505
3/16	-6	.112	.0017	.0566	3/16	-5	.075	.0013	.0569	3/16	-7	.075	.0015	.0474
	-9	.313	.0018	.0755		-6	.102	.0013	.0597		-8	.102	.0017	.0502
	-14	.601	.0026	.0953		-7	.125	.0017	.0587		-8	.125	.0017	.0518

Comparative Cost Of Standard Parts

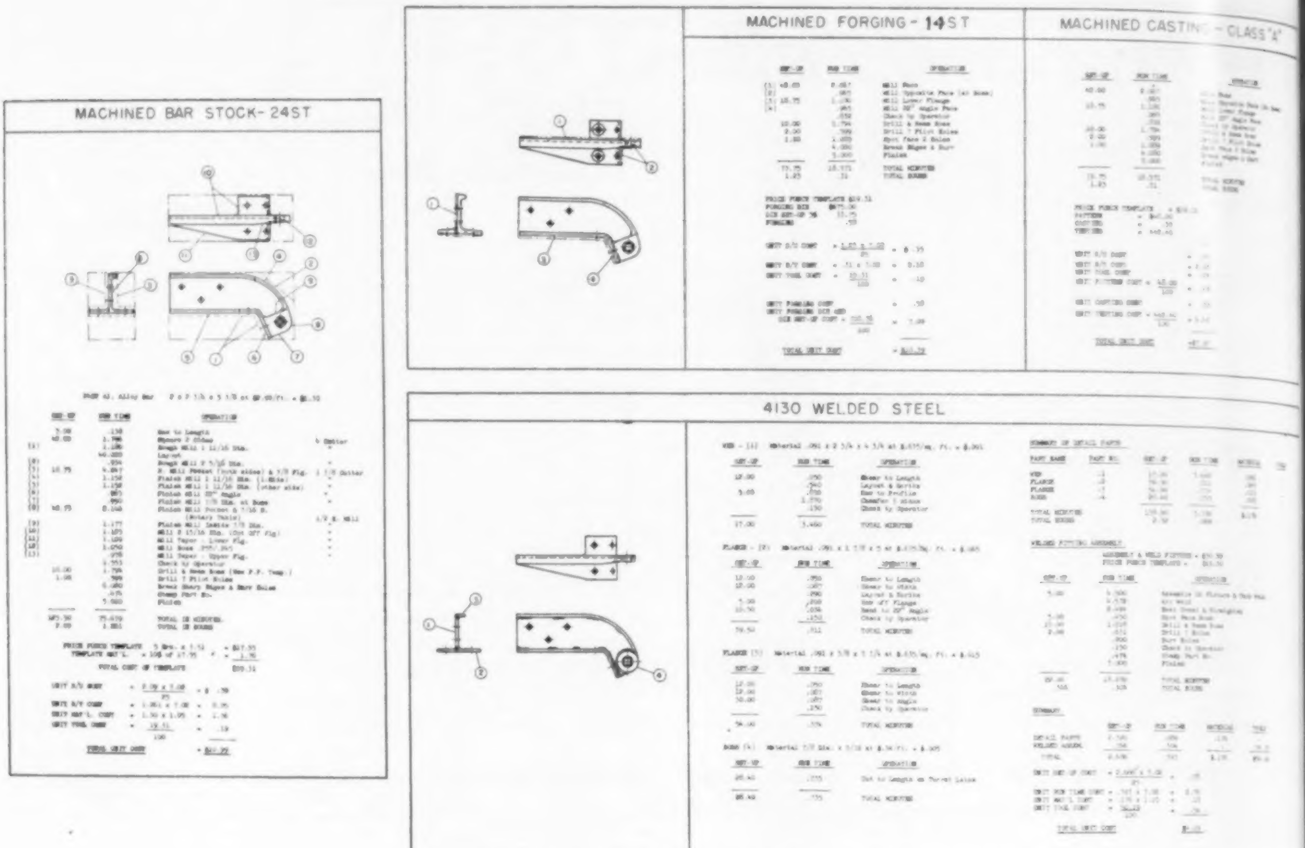


Fig. 12. Fitting summary sheet—door aft hinge.

Fig. 13. Fittings cost breakdown evaluation.

STUDY NO.:______
DATE:______

COST CONTROL GROUP
PRODUCTION DESIGN SECTION—ENGINEERING DIVISION

COMPARATIVE COST SUMMARY SHEET MODEL: P4M-1

TITLE: FITTING ASSY. - MAIN GEAR OLEO DOOR AFT. HINGE

DRAWING NO.: 20-21-0713

ANALYSIS: 24ST Machined Bar Stock - VS - 24ST Machined Forging - VS Welded Fitting H.T. to 125,000 P.S.I. - VS - Al. Alloy Casting Class "A"

PREMISES: Total of 100 parts. Production lots of 25 parts per lot. Tool & labor hours were coordinated with representatives from Tool Engineering & Detail Manufacturing.

SUMMARY:

ITEM	BAR STOCK		FORGING		WELDED		CLASS "A" CASTING	
	TOTAL COST	UNIT COST	TOTAL COST	UNIT COST	TOTAL COST	UNIT COST	TOTAL COST	UNIT COST
MAT'L		1.36		.58		.18		.30
PURCHASED EQUIPMENT								
FIXED TOOLS DETAIL	19.31	.19	19.31	.19	50.19	.50	19.31	.19
FIXED TOOLS ASSEMBLY								
DETAIL SET-UP	14.67	.59	8.63	.35	18.86	.75	8.63	.35
DETAIL LABOR		8.85		2.18		2.76		2.18
ASSEMBLY SET-UP								
ASSEMBLY LABOR								
DIE			708.75	7.09				
PATTERN							48.00	.48
ENGINEERING COST								
SPEC. TEST							442.40	4.42
TOTAL UNIT COST		10.99		10.39		4.19		7.92
UNIT WEIGHT	.229 LBS.		.321 LBS.		.437 LBS.		.417 LBS.	

REMARKS: As indicated by the above figures, the welded fitting proves to be the most economical to manufacture, however, to realize this savings a weight penalty of .208 LBS/PART would have to be accepted.

ACCEPTANCE OF COST DESIGN DECISION:______ DATE:______
PREPARED:______ DATE:______ APPROVED:______

ting. The testing cost is amortized over the quantities of purchased casting. This testing cost is composed of structural engineering and laboratory costs.

Combining the material, fabrication and testing cost gives the total unit manufacturing cost for each fitting: $10.99 bar stock; $10.39 forging; $4.19 welded and $7.92 casting.

The weldment proved to be the most economical for the quantity of parts under investigation. A critical review of this typical cost breakdown, Fig. 12, for each method of fabrication enables the engineer to determine why certain designs are more costly than others so that he can take the necessary steps to modify the design to facilitate economical production.

As emphasized in the early part of the fitting analysis, quantity of parts to be made has a direct bearing on the method of manufacturing and the type of material selected. The importance of the statement is graphically portrayed in Fig. 14 which shows the quantity of parts against manufacturing costs. Notice that, up to 4 parts, the machined bar stock fitting is the recommended design, with the welded fitting the most economical design from 4 to 520 parts; beyond this number of parts the casting becomes the best method of manufacturing.

The efficient assembly of this fitting to the airframe structure is another controlling factor where the designer can express his ingenuity to initiate an economical method of attachment.

To approach this problem, the designer again has the facilities of the design bulletins, in this case Design Bulletin No. 3, "Comparative Cost of Standard Parts." Turning to Page 4 in the bulletin, as shown in Fig. 15 the various costs of bolting attachments can be easily selected.

In this particular attachment problem, the fitting is subjected to large structural loads to support the operating action of the landing gear.

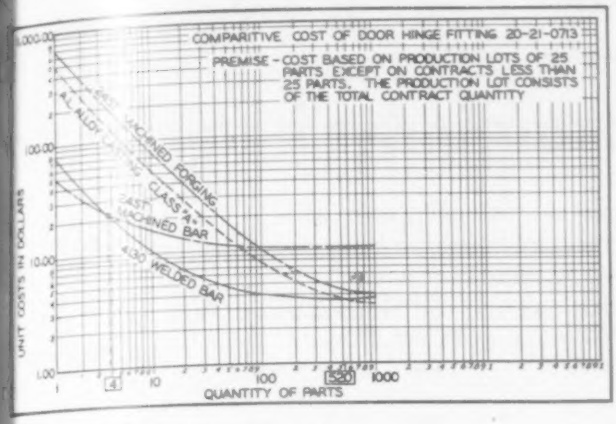
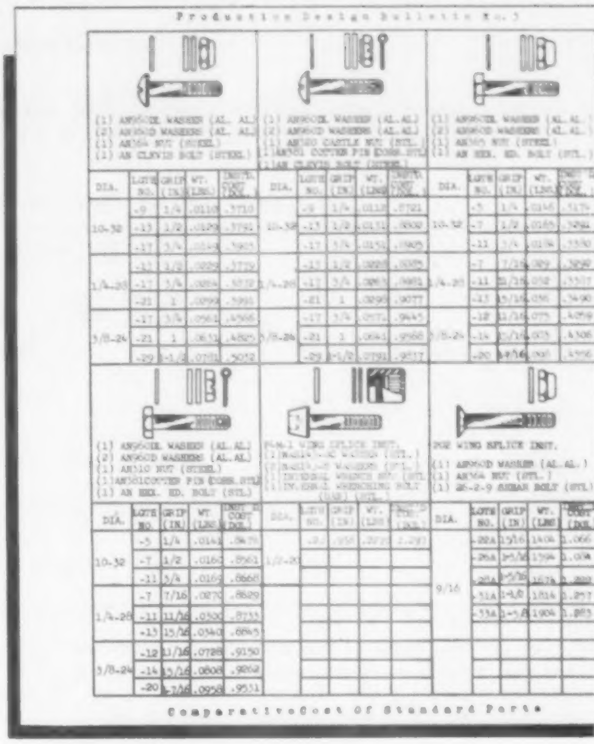


Fig. 14. Fitting quantities versus costs.



Production Design Bulletin No. 3

(1) AN960L WASHER (AL. AL.)
(2) AN960D WASHERS (AL. AL.)
(1) AN364 NUT (STEEL)
(1) AN CLEVIS BOLT (STEEL)

DIA.	LGTH NO.	GRIP (IN)	WT. (LBS)	INSTL. COST (DOL.)
10-32	-9	1/4	.0110	.3710
	-13	1/2	.0129	.3741
	-17	3/4	.0148	[illegible]
1/4-28	-13	1/2	.0229	.3779
	-17	3/4	.0264	[illegible]
	-21	1	.0299	.3991
3/8-24	-17	3/4	.0561	.4566
	-21	1	.0632	.4825
	-29	1-1/2	.0701	.5032

(1) AN960L WASHER (AL. AL.)
(2) AN960D WASHERS (AL. AL.)
(1) AN320 CASTLE NUT (STL.)
(1) AN381 COTTER PIN (CORR. STL.)
(1) AN CLEVIS BOLT (STEEL)

DIA.	LGTH NO.	GRIP (IN)	WT. (LBS)	INSTL. COST (DOL.)
10-32	-9	1/4	.0118	.7721
	-13	1/2	.0131	[illegible]
	-17	3/4	.0152	[illegible]
1/4-28	-13	1/2	[illegible]	[illegible]
	-17	3/4	.0263	[illegible]
	-21	1	.0298	.9077
3/8-24	-17	3/4	.0571	.9445
	-21	1	.0641	[illegible]
	-29	1-1/2	.0791	[illegible]

(1) AN960L WASHER (AL. AL.)
(2) AN960D WASHERS (AL. AL.)
(1) AN365 NUT (STEEL)
(1) AN HEX. HD. BOLT (STL.)

DIA.	LGTH NO.	GRIP (IN)	WT. (LBS)	INSTL. COST (DOL.)
10-32	-5	1/4	.0145	[illegible]
	-7	1/2	.0165	[illegible]
	-11	3/4	.0194	[illegible]
1/4-28	-7	7/16	.029	[illegible]
	-11	11/16	.032	[illegible]
	-13	15/16	.036	.3490
3/8-24	-12	11/16	.075	.4059
	-16	15/16	[illegible]	.4306
	-20	1-7/16	[illegible]	[illegible]

(1) AN960L WASHER (AL. AL.)
(2) AN960D WASHERS (AL. AL.)
(1) AN310 NUT (STEEL)
(1) AN381 COTTER PIN (CORR. STL.)
(1) AN HEX. HD. BOLT (STL.)

DIA.	LGTH NO.	GRIP (IN)	WT. (LBS)	INST'D COST (DOL.)
10-32	-5	1/4	.0142	[illegible]
	-7	1/2	.0162	.8561
	-11	3/4	.0169	.8668
1/4-28	-7	7/16	.0270	.8629
	-11	11/16	.0300	.8733
	-13	15/16	.0340	[illegible]
3/8-24	-12	11/16	.0728	.9150
	-14	15/16	.0808	.9262
	-20	1-7/16	.0958	.9531

FOR WING SPLICE INST.
[illegible]

DIA.	LGTH NO.	GRIP (IN)	WT. (LBS)	INST'D COST (DOL.)
1/2-20	[illegible]	[illegible]	[illegible]	[illegible]

FOR WING SPLICE INST.
(1) AN960D WASHER (AL. AL.)
(1) AN364 NUT (STL.)
(1) 26-2-9 SHEAR BOLT (STL.)

DIA.	LGTH NO.	GRIP (IN)	WT. (LBS)	INST'D COST (DOL.)
9/16	-22A	1-5/16	.1404	1.066
	-26A	[illegible]	.1594	[illegible]
	-28A	[illegible]	[illegible]	[illegible]
	-31A	[illegible]	.1814	[illegible]
	-33A	1-5/8	.1904	[illegible]

Comparative Cost Of Standard Parts

Fig. 15. Fitting installation costs.

Checking with the Stress Group, it is necessary to use 4 AN-3-5 bolts, 3 washers and elastic stop nut, also 3 AN-4-7 bolts with the same number of washers and stop nuts. Studying the listed bolt cost, the selection indicates that the AN-3-5 bolts cost $0.32 each or a total of $1.28 and the 3 AN-4-7 bolts at $0.33 each, totaling $0.99. Thus, the total installation cost for attaching the fitting to the frame structure will be $2.27. The hinge bolt AN-6-20 with 3 washers, castellated nut and cotter pin cost $0.95 each to attach the door to the hinge fitting. The designer can further expand his search of installation costs, if Stress will permit, by suggesting a rivet assembly and comparing this cost with the bolted assembly.

Design Histories

In Fig. 16, a flap hinge bracket, is an examination of a design history of the more complex type of material selection to achieve economical manufacturing, minimum weight and efficient functioning under very high structural loads.

The flap is a movable section of the trailing edge of a wing which is lowered to give added lift in taking off and act as an air brake when landing. It is hinged, with brackets having their centerline about 15 inches below the wing contour. Thus, these brackets are in the airstream and must have good aerodynamic properties and structural integrity to take air loads up to $3\frac{1}{2}$ tons per bracket.

The first design proposal, No. I, is composed of a skeleton truss affair covered with a sheetmetal fairing. The truss is a forged 75S fitting requiring considerable machining of faying surfaces. The member attaching to the upper spar chord is 30 inches long with half of it unsupported. It was anticipated that the machining of this unsupported length would cause warping and require considerable time for straightening. This proposal was next compared with a typical hollow casting as shown in Design II. From the manufacturing and material standpoints, this design costs 60 percent less to fabricate but indicates a weight increase of 4.59 lb, making its use prohibitive.

The next design, III, suggests a composite assembly of 2 dimple 75S forgings, with a small casting to hold the bearing, which are bolted together and covered with sheet metal. This resulted in a substantial weight savings, but the cost reduction is only 13 percent in relation to design I. Since the cost is still considerably more than the hollow casting, a fourth design, IV, was sought.

This design utilized a skeleton truss as in design I but used a casting which reduced both tool and material costs. Its unit cost is only slightly higher than the hollow casting, design II, with a weight midway between the hollow casting and composite designs. To complete the picture, a fifth design, V, was analyzed as a welded steel assembly. This unit turned out to be heavier and more costly than the original forged design I.

Referring to the summary, Fig. 16, it is evident that the decision of which design to use must be based on a compromise between cost and weight.

Review of this summary cost and weight data reveals that type IV (casting and sheetmetal design) is the proper selec-

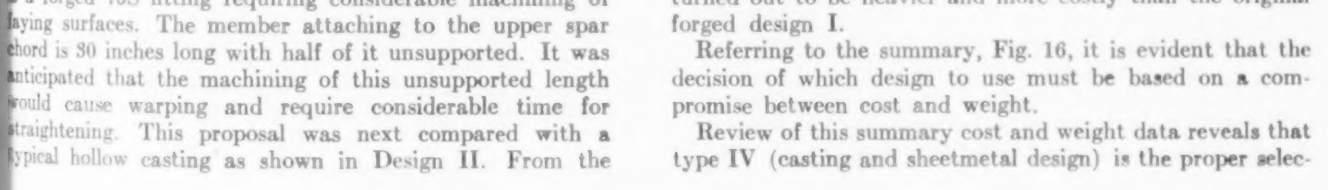


Fig. 16. Design history on flap hinge bracket.

FIG. 16B—COMPARATIVE COST EVALUATION OF ALTERNATE DESIGNS

FLAP HINGE BRACKET—REMOVABLE FITTING

The flap hinge center line on the P5M-1 is located below the wing mold line by approximately 20 inches. Any structure thus exposed to the air stream must have good inherent aerodynamic properties or be covered with a streamlined fairing.

COST BASED ON 100 UNITS MANUFACTURED IN LOTS OF 25 UNITS EACH

TYPE OF CONSTRUCTION	TOTAL NO. PARTS	TOTAL WGT. LBS.	NO. OF FASTENERS			*		PROJ. AREA SQ. FT.	COST DATA (DOLLARS)					
			ERCO	BLIND FASTEN	VIBR. RIVETS	DIES	PAT-TERNS		COST OF MAT'L.	COST OF TOOLING ONLY	UNIT DETAIL COST	UNIT ASSEM. COST	UNIT COST INCL. TOOLS	COST PER LB.
TYPE I 75ST FORGING AND SHEET METAL	6	12.49	—	52	20	3000.00	180.00		$42.66	2655.00	19.92	4.46	93.59	7.48
TYPE II CASTING	2	17.08	—	—	—		400.00 180.00		30.45	515.00	1.93	—	37.53	2.20
TYPE III COMPOSITE	16	10.49	—	46	190	3200.00	180.00		16.18	2594.50	27.01	12.08	81.22	7.74
TYPE IV CASTING AND SHEET METAL	6	14.30	—	52	20		350.00 180.00		26.76	1185.43	4.87	4.13	47.61	3.32
TYPE V WELDED STEEL ASSEMBLY	14	12.84	—	46	118		180.00		12.71	2072.75	23.79	40.18	97.41	7.58

REMARKS: Of the types analyzed, Type IV is selected as the best design to use on the P5M-1. The cast frame work with sheet metal fairing reduces the shop loading time, presents no serious manufacturing problems, and can be economically produced. However, Type IV provides a weight penalty of 3.81 lbs. over the lightest design studied at a savings of $33.61/unit. The weight cost penalty for Type IV then becomes $8.82/pound, which is within the basic $30.00/pound figure, and thus will be used on the production ship.

*Total cost for dies and patterns. Since they can produce left and right-hand parts, one-half of this cost was included in the tooling cost in order to obtain the unit cost per fitting.

tion since its low manufacturing cost and weight evaluation reaches the balance that is necessary to solve the problem of the flap hinge bracket design.

Design histories presented in this form help to establish standardization of design and serve as a stepping stone for the development of future designs. They also render a basis for comparing the design features and cost evaluations of these problems to achieve a scientific approach to sound engineering practices.

Therefore, by the application of design bulletin information and cost control techniques aligned with efficient functional engineering, the completeness of the design progression cycle is conceived. Finally, the most important result of these applied techniques is the achievement of overall co-ordinated efforts of engineering, tool design and manufacturing; a necessary requirement for profitable product development.

The Technique of Micro-Drilling

By J. A. Cupler

GENERAL MANAGER
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MICRO-DRILLING BEGINS when the factors governing an operator's treatment of a drill and technique in using it are no longer apparent to him without the aid of sensitive drilling equipment and optical aids. My reference here is to cuttings and the story they have to tell to the operator concerning the quality of the cutting edges of the drill itself and the peculiar nature of the material which is being drilled—in short, its machinability or drillability.

Drill Life

In micro-drilling the specific factors affecting drill-life according to our observations are as follows:

1. The material or alloy from which the drill is made.
2. The physical structure of the drill, that is, if a twist drill, web thickness, point angle, rake angle, and cutting clearance on the side of the drill. If a pivot or spade type drill, web thickness, point and rake angle and back taper or clearance on the drill blade itself. The points and rake angles of drills must be made to conform to the requirements of the particular material which is being drilled. The point angles will vary normally from 118 deg for soft materials to approximately 135 deg for harder materials and the rake angles from 8 deg to approximately 15 deg over the range of conventionally drillable materials.
3. The rpm of the drills, since this rpm necessarily varies in the drilling of different materials, is one of the major factors affecting drill life or the lack of it.
4. With specific reference to micro-drilling, the most vital factor affecting drill life is the trueness or concentricity with which the drill turns.

It is very difficult, if not impossible, to develop an adequate chart pertaining to speeds and feeds in the drilling of various types of materials when using small and microscopic drills, since there are so many variables and influencing factors. With respect to speeds and feeds, there is no such thing as a straight-line curve relationship between the two. Although in some cases speeds of 7,000 rpm have been used successfully, it can generally be depended upon that speeds in excess of 4,000 rpm for drills as small as 0.020 in. diameter are impracticable. Speeds not in excess of 2,800 rpm generally will give the most satisfactory results as to hole quality and drill life regardless of the material to be drilled. These rules on rpm are based on maximum drill life, maximum hole quality coupled with duplication of hole size over many hundreds of holes. Deviation from these basic rules will not result in inability to drill, but a penalty will be paid. It will result in shorter drill life, more burring, tapered or funnel-shaped holes or increasing inability to duplicate hole size to close tolerances. If any rules should be kept in mind regarding speeds and feeds in the use of small and microscopic drills, it should be this: As the drill decreases in diameter below 0.020 in. the rpm should be decreased rather than increased and the infeed per revolution of the drill should be compatible with the ability of the drill to withstand the torque. The operator should bear in mind that as the diameter of the drill is decreased one half, the area is four times less and consequently, the torque resistance is considerably less.

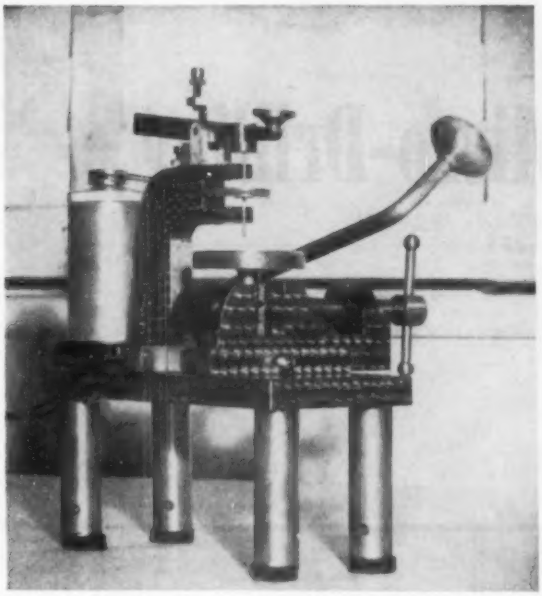
Speeds and Feeds

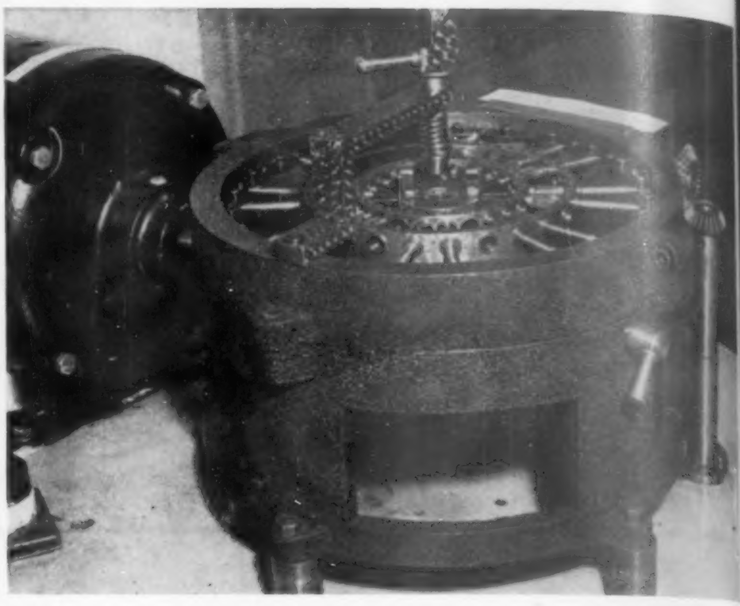
It is axiomatic that in true drilling the drill must remove stock on each revolution. The amount of stock removed per revolution will be determined by the infeed of the drill. Let us say that the maximum infeed of the drill will be determined by the ability of the drill due to its size to withstand the torque or the reverse stress placed upon it as influenced, of course, by the rake angle back of the cutting edges and the rpm. Every material has an inherent resistance to abrasion or cutting and the rpm of the drill must be kept well within these resistance limits in order to observe good drilling practice. From practical experience, we have found that this means comparatively slow drilling speeds.

If a drill is 0.006 in. in diameter and is employed to drill through approximately 0.035 to 0.040 in. of steel (stainless, alloy tool steel or cold rolled) at speeds from 10,000 to 100,000 rpm which we have found to be wide-spread practice, the drill—if it removed stock for each revolution at these very high speeds—would drill the hole completely through in a second, more or less. This, we know from experience, is not possible and since we know that such holes can be drilled satisfactorily in approximately ten seconds, we therefore conclude that when an excessive rpm is employed, the drill is gliding over the work surface, abrading the cutting edge of the drill and at the same time work-hardening the surface through which it must drill.

The Micro-Drill

In the matter of the flexible drill, we have found that the hardest and the shortest drill blade is the best for accurate production drilling. The reason for the universal acceptance of the drill which is somewhat flexible is that it will, to some extent, compensate for inaccurate chucking devices, sloppy spindles, excessive vibration, and lack of good operator-control of the drill, due to basically improper design of





(Left) bench model drilling machine employing vee-block principle and simple leverage mechanism. (Right) Multiple spindle watch balance wheel drilling machine used for high precision micro-drilling. This also employs the vee-block principle.

spindle depressing mechanisms. The art of drilling is in the controlling or restricting of the work which the drill is permitted to do. This also means the controlling of the reverse stress to which the drill is subjected.

How the Drill Is Made

Most truly micro-drilling today is done with oversize shank drills, although the drill points or blades may be of the spiral type as these are generally available. Since this type of small and microscopic drill must rotate true—at least within the limits of the back taper of the blade—eccentric rotation which may be caused by conventional chucks results in abuse to the drill. In recent years, improvements have been made in the nature of adjustable chucks, such as the ball chuck, which permits the truing of the drill by engaging it (while running) with the fingernail or some other object and then locking the chuck in position. This has been a worthwhile advantage, although it can be appreciated that if the drill point is still not concentric with the shank, the employment of the shank as a truing medium can only be a relative improvement.

This eccentricity of operation has also been overcome by the V-block principle which makes possible the grinding of opposed flats on the drills to uniform depth and the accurate and uniform generation of point and rake angles.

Drill uniformity is of the utmost importance since drills which do not turn in a concentric fashion are rapidly fatigued and rapidly broken. Flats or webs which are off-center will drill oversize holes. Point angles which are not uniform will cause drills to cut only on one lip. They will unduly strain the drill and will cause the drill to cut oversize and other than uniform holes even to the extent of their being egg-shaped. Lack of uniformity in the rake angles of the drill will permit undue reverse stress to be placed upon it, particularly if used in drilling equipment employing the rack and pinion principle. These factors apply to drills regardless of their hardness properties; however, from a breakage standpoint, the hard drill is most seriously affected. Specific factors which influence the size and quality of the hole to be drilled as well as drill life, are: (1) back taper or clearance on the drill blade; (2) point angle; (3) rake or clearance angle back of the drill point; (4) web thickness and drilling pressure as influenced by web thickness.

Controlling Hole Size and Quality

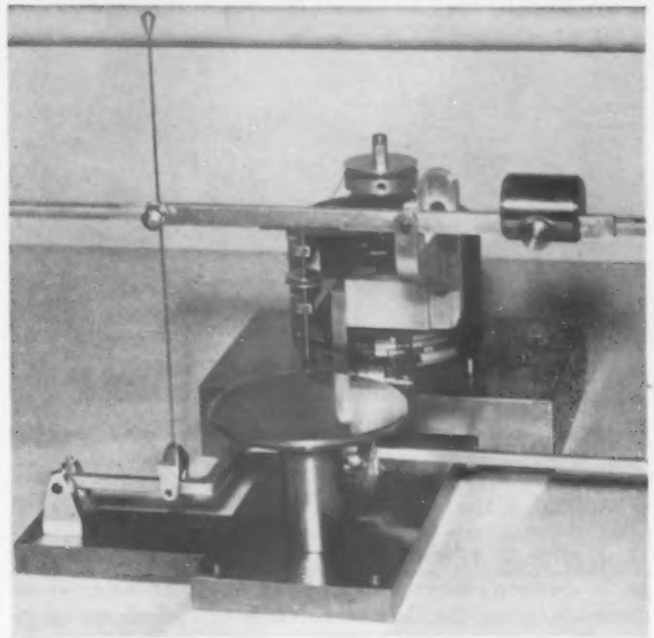
Drill diameter is only one factor governing hole size. The drill must be checked absolutely true, preferably under a 20 power binocular and in chucking true care must be taken that the drill is very tightly chucked so that under drilling pressure it will not have a tendency to flex in the collet. Since any tool is as strong as its weakest point, back taper or clearance on the drill blade should be held to very close tolerances.

Web thickness determines hole size by governing pressure necessary to make the drill cut. If we will look directly at the cutting end of a pivot or spade-type drill, we will see a line across the end of the drill which has no cutting ability whatsoever. The minimum length of this line will be determined by minimum web thickness required to give the drill necessary strength. The thicker the web, the longer the line becomes and the pressure necessary to make the drill cut. The more pressure used in drilling, the larger the hole will be in relation to the diameter of the drill.

The line visible on the end of the drill has no *cutting ability*, as has been said, and increased rake angle causing the line to become lengthened and angular in relation to the flats has simply the *effect* of increasing the initial web thickness without introducing some of the other undesirable results of too thick a web. The point angle helps to determine hole size since the longer the point angle, the more centering effect is created for the drill. The blunter the point angle, the greater care and skill must be exercised on the part of the operator in order to control hole size as could be determined by point angle. Since with the blunt point angle there is not the exaggerated centering effect available with the longer point angle, we can assume that in production less accurate holes will result. On the other hand, with the longer point angle, the drill will be subjected to much greater reverse stress and the effective life of the drill will be reduced.

Since drilling pressure in itself will help to determine hole size, one of the important factors to consider therefore is that the operator develop a sensitive touch to the point that he can duplicate drilling technique and drilling pressure over thousands of holes. Sustained cutting pressure should be employed at all times when drilling metal which has a

Top view of multiple spindle balance wheel drilling machine.



Bench model drilling machine having vee-block principle.

tendency to work-harden or glaze, and care should be taken that the drill is never allowed to dwell in the metal without being progressively fed. At the same time, it must be remembered that you cannot create an undue amount of torque on the tiny drill and reciprocation of the drill must be constantly exercised.

Stock Removal

Since the tendency of the drill is to act like a screw, when it is permitted to bury its cutting edges in the metal, it wants to pull itself down into the metal, bind and break off. This fact serves to impress us with the necessity for controlling the amount of metal which the drill is permitted to remove at any one time. It should also be remembered that sustained torque is injurious to a drill even though it may appear to be holding its cutting edge and not twisting under the continued drilling of a few dozen holes. If the proper amount of stock is removed per reciprocation of the drill and the proper drilling pressure is used, thousands of holes may be drilled without damage to the drill. Occasionally, through bad annealing of the stock, hard spots will appear in the metal which have not been caused by cold work-hardening. They represent a condition which must be overcome purely by drilling technique and in such a fashion as to abuse the drill as little as possible. In breaking through such hard spots which may be no thicker than .001 or 0.002 in. the operator should sharply peck at the exposed surface of the metal with the drill in order to cause the drill periodically to act as a trip hammer. Thus the shock will help to break the surface and permit the cutting edge to take a bite without abrading that cutting edge.

Use of Coolants

Hole size and wall finish will be determined not only by the tool itself and the technique with which the operator uses it but by the quality of the cutting compounds or oils used in drilling. The life of the tool will also be greatly affected by the use of coolant or the lack of it. For general work, any light base cutting oil is recommended for this small drilling. Carbon tetra-chloride, of course, is the most efficient but has other drawbacks which render it undesirable. Cutting compounds, drilling pressure, and web thickness combine to help determine wall-finish and to create conditions known as galling or on the other hand, burnishing of the walls of the hole. This is especially true of the pivot drill. Since the cutting edges of the drill are never entirely exposed, the round sections of the drill at the cutting end, opposite the flats, presents to the wall of the hole being drilled a burnishing area and if the web thickness be too thick, a galling area. This burnishing ability of the pivot drill explains its tendency to produce the most accurate and smooth-walled holes of any known drill, especially in the small and microscopic diameters.

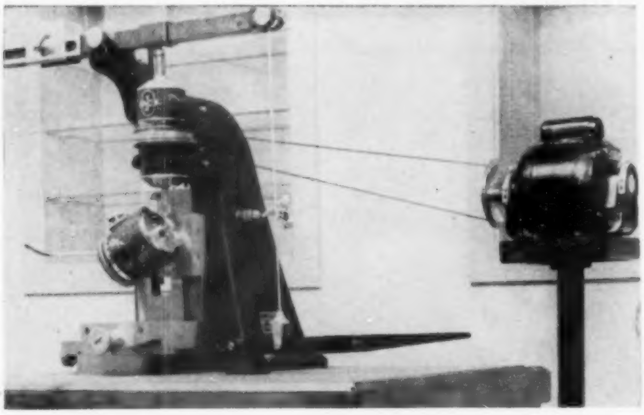
New Drilling Equipment

One of the requisites in micro-drilling is the need to control perfectly the infeed of the drill and the relieving of the drill from engagement with the work-piece.

With the rack and pinion feed, there is an interval between the time when the drill is being actively fed into the workpiece and the time when it is retracted or removed from the work surface during which the drill can do exactly as it pleases, namely, act like a screw, using up the excess play supplied by the rack and pinion. Such a machine principle, while very practical in conventional-size drilling, is not conducive either to long drill life or good hole quality.

The problems of high frequency and vibration are, in addition, sometimes overlooked in micro-drilling. Vibration is one of the greatest hazards to small and microscopic drills since it not only acts as a trip hammer—in effect pounding the cutting edges off the drills—but it robs the operator of the very necessary sensitive touch which is necessary for successful and accurate micro-drilling.

There are two further points which should be considered. First, if the drill is so small that the operator cannot adequately see its action or the nature of the cuttings, and the leverage ratio and sensitivity are such that he cannot adequately feel the action of the drill, and the touch is further complicated by the presence of vibration, he is trusting entirely to luck in the accomplishment of his drilling goal. Second, if adequate optical aids are provided and the vibration still remains present and the leverage ratio and sensitivity are not increased in direct proportion to the visual



Drilling machine setup showing index head set for drilling diesel fuel nozzles.

magnification, the operator will be subjected to an exaggerated nervous strain whether his production requirements be much or little. If, for example, in drilling with a drill 0.006 in. in diameter, direct spindle pressure of one ounce is required to cause the drill to cut and an optical aid of 20 magnifications is employed, a spindle-actuating leverage principle should be employed, lessening the required finger pressure to approximately 1/20 of one ounce and providing a spindle travel of approximately 0.001 in. for every 0.020 in. of lever or finger travel. Thus, the operator will be working in a normal world as relates to sight and touch; and barring the presence of excessive vibration, should be able to determine by the nature of the cuttings, the quality of the cutting edges on the drill, as well as the condition of the material which he is drilling. For example, if the cutting lips of the drill are uniform and the material being drilled is properly annealed, the drill should be able to produce two spiral cuttings at the same time, one from each cutting lip. The operator will be able to tell from drilling pressure required to make the drill cut whether or not the drill is sharp. If he should run into progressively harder metal in the work piece, the cuttings will begin to take the form of ships and in the case of hard spots, the swarf or cuttings will assume the appearance of black powder.

The V-Block

One approach to micro-drill control has been the V-block which, instead of employing bearings, has two opposed vees made of wear-resistant synthetic material. The drill shank which has been ground and lapped round and straight after heat treating or hardening has had a drill point ground upon one end absolutely concentric with the shank. A small pulley is fitted on this drill shank and the drill shank is laid into the vees, becoming its own spindle. A belt made of four-pound fishing tackle, approximately 0.0100 in. in diameter, is placed over the pulley and also engages the pulley of a remote low-speed, balanced, vibration-dampened motor. The pull of the belt holds the drill solidly in the vees so that it has line contact at all times with the vees. The equivalent of spindle and bearing tolerance is absolute zero, and as wear might conceivably occur in time, this tolerance will still remain zero until such time as the wear points are entirely worn out. The upward pull of the belt retracts the top beveled end of the drill shank up against the depressing arm. Thus the drill has been made concentric and must now operate in a similar concentric fashion in a drilling machine because it is being used exactly the same way it was made.

The Future of Micro-Drilling

Micro-drilling, and especially precision micro-drilling, is becoming of increasing importance in that it is possible to drill so accurately that secondary operations are frequently not necessary. Elimination of secondary operations such as reaming constitutes a real and important saving in the industries where literally millions of holes are drilled monthly and yearly, such as the diesel engine industry. The small multiple holes in the fuel nozzle are the heart of the diesel engine, and therefore a vital part of our everyday lives. The microscopic precision hole is important in the synthetic silk and yarn industry, particularly in the spinnerettes which employ multiple holes in the nature of 0.0015 to 0.0020 in. diameter in precious metals and stainless steel for the extrusion of synthetic silk and yarn filaments.

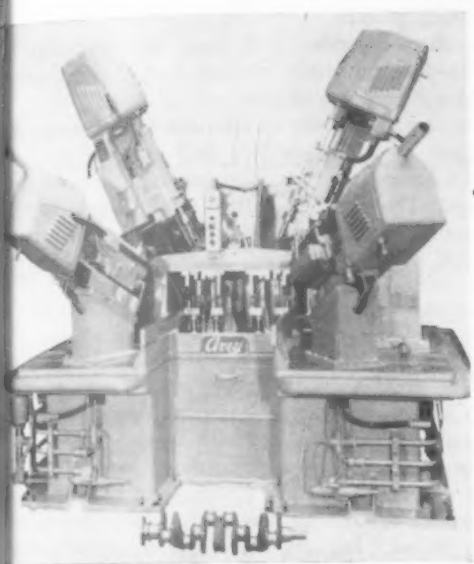
The watch and instrument industry depends largely for its existence on the small hole, and must increasingly in the future, to compete with the less expensive foreign labor such as that incorporated in the fine Swiss watches, which are imported in such plentiful quantities.

In the medical instrument industry, there is the so-called hypo-spray which employs the use of a small precision hole in a device which injects medication hypodermically. If the hypo-spray, as one of the first major applications of small precision holes in the medical field, should, as I anticipate, successfully pass its clinical tests, it will mean the production of millions of precision holes per day.

Generally speaking, as our mechanical age grows and refines itself, we find our instruments and our gadgets becoming smaller, more refined and more complex. We find the weight factor in aircraft all important. This means that many instruments must be kept as light as possible. Micro-machining and micro-drilling make possible the use of micro-parts in these intricate instruments.

Stereoscopic shop binocular microscope used in conjunction with micro-drilling equipment.

Application of Drill Units To Standard and Special Machinery



By Eugene Numrich
APPLICATION ENGINEER
AVEY DRILLING MACHINE COMPANY

DRILLING IS A DISTINCTIVE type of operation. The ma-ines and the cutting tools associated with these machines e probably used more than any other metal removal vice, yet they do not always receive as much consideration their importance justifies. The drill is rarely relied upon produce holes to close tolerances; usually reaming, broach-g, grinding or lapping operations follow, the selection de-nding on the accuracy and finish required. Drilled holes n be produced more accurately than they are usually achined if particular attention is given to the grinding of e drill, and the addition of a drill bushing or a bushing ate carrying suitable bushings. By suitable bushings, it is ferred, they should come close to the contour of the part r the start of the drill to keep the drill rotating with inimum amount of run-out.

Drilling equipment should be selected so that specific bs can be done better and at a profitable rate. This form producing holes can be obtained only by lowering unit oduction cost.

There are several methods for consideration: (1) Stand-d machines equipped with multiple spindle drilling heads f necessary) and a progressive type fixture, which can be oved along the machine table from one spindle to an-her. This routing over multiple spindle machines has oven very economical when the production was not too gh, and it would require several special machines to tain the same result. The second method involves semi-ndard or entirely special machines. The special, single rpose equipment must be economically designed and still ve the ability to produce parts at a good rate of speed ing the optimum feeds and speeds which should result maximum tool life.

When designing a special drilling machine, one of the important factors is production requirements. This dictates the type of units to be used, whether automatic or hand index tables are in order, automatic or hand clamping fixtures and in some instances, hopper loading and automatic ejection of the workpiece.

Automatic controlled cycles will eliminate idle machine time, as the work pieces are usually removed and loaded in the work holding fixtures while the drilling, reaming, tapping, and kindred operations are taking place.

Basically there are two types of drilling units, the cam feed and the hydraulic feed.

The cam feed units are made in several sizes and lengths of stroke. In addition to performing drilling operations, they are also used for tapping when equipped with a reversing motor and control. They can be placed horizontally, vertically or at any angle dictated by the workpiece. Each unit has a specially engineered cam which imports an automatic cycle of rapid approach, feed, dwell at the end of the feeding stroke if necessary, and rapid return to the starting position. The length of the feed and the rate of feed as well as the rpm are special for a particular material and length of hole.

Many parts, particularly the crankshaft used in the construction of automotive engines, require a series of holes to be drilled at a given angle and running from the main bearings to the connecting rod bearings. These holes are from 3/16 to ⅜ in. in diameter, and vary in their length depending on the sizes of the crankshaft and its throw. Generally speaking, when the length of hole exceeds three times the drill diameter, it is known as deep-hole drilling and calls for special drills. These differ from standard twist drills, as the web is much heavier and the spiral somewhat faster.

The success in drilling deep holes of small diameter on a production basis is the ability of the unit to withdraw the drill, bringing out the chips, (and allow coolant to flow on the bottom of the hole) just before they become packed and cause a binding action.

Deep hole drilling is successfully being done with a unit incorporating hydraulic feed. The drilling device withdraws the cutting tool automatically at a rapid rate when the strain on the tool becomes excessive. The torsional load which a particular size drill can carry safely (just below the breaking point) is applied to the spindle drive

sleeve through cams from a driven pulley which is directly controlled by a predetermined amount of spring pressure on the cam plate. The movement of the cam plate can be controlled by the torsional load applied for driving (and permitting drill withdrawal), by the switch in turn, operates a solenoid through a relay to withdraw the drill.

Tests have shown when the torque is increased to a point where it is necessary to withdraw the drill, the sensitivity of this device is such that in 10 revolutions or less, (approximately 0.05 second) the switch is excited and withdrawal begins. The drill used was 9/32 in. diameter, running at 800 rpm.

Hydraulic units are also constructed using a step feed, and some are cycled similar to the cam feed unit. Hydraulic operation is more flexible because the feeding rate can be changed by a metering valve whereas the mechanically-operated cam feed unit has a fixed rate of feed.

Practically all types of rotating cutting tools are used on these units, especially when built into special machinery. In quite a few instances, milling heads are employed and in a lesser degree, broaching tools. These are generally fitted to cam feed units.

Multiple spindle heads play an important part in production type machinery. There is practically no limit to the applications of these heads. Wherever possible, they should be engineered to cover more than one station in order to cut down the number of drilling units.

Many styles of multiple heads are used today and the selection depends upon several factors. The material from which the workpiece is made, the size of the cutting tool and material (high speed steel or tungsten carbide) and if the head is to be adjustable or fixed. Generally speaking, multiple heads should not run over 2,000 rpm with an oil circulating arrangement. These are not exact recommendations since, as the numbers of spindles increase, the run must be lowered accordingly.

Standard Fixed Center Multiple Head

This is a full ball bearing design and is furnished where center distances between the holes to be drilled will permit the use of ball bearings.

It is lubricated by grease and not recommended for speeds over 2000 rpm.

Close Fixed Center Multiple Heads

This type of head is furnished for jobs where the centers are too close to furnish a full ball bearing spindle construction, but in every case the tool thrust is taken on a heavy duty angular contact ball bearing.

It is lubricated by grease and recommended for speeds not over 2000 rpm.

Oil Circulating-Type Multiple Spindle Drill Heads

This head is mainly used for high speeds and long life. They have been operated with success at speeds above 10,000 rpm. They are designed to eliminate all rubbing parts, such as oil seals. It contains a built-in vane type oil pump.

The universal multiple head is mainly used for small job lots. The spindles are readily adjusted to new locations in a small amount of time. Slip spindle plates can be furnished for locating the spindles to various patterns. This plate, which mounts on the bottom of the head, can be bored for one or more workpieces and gives the advantage of a fixed center head.

Standard Adjustable Multiple Spindle Drill Heads

This type of head is gear-driven and is made with two or more spindles constructed in a form of an eccentric drum. The spindle can be adjusted to any desired location within the range of the head and locked, giving the advantage of the fixed-center type. It is, however, limited to a minimum center distance for a given size drill and for equal spacing of holes.

Double Eccentric Adjustable Multiple Spindle Drill Head

This head is similar to the standard adjustable head except that the range of adjustment is much greater. Spindles can be adjusted to any desired pattern, irregular, circular, rectangular, etc., and can be built with any amount of spindles. The spindles are located by means of a jig-bored plate fastened to the head by studs. A different plate is required for each pattern.

Another multiple spindle drill head, the Adjustafix, is designed to reduce multiple drilling cost by eliminating changes in set-up from job to job.

Most of the drill head can be left intact, and changeover is accomplished by changing the drill pattern plate and relocating spindles on the new pattern plate to conform to the new design. The number of drill patterns possible with this drill head is limited only by the number of pattern plates available.

Individual Lead Screw Tapping Head

The individual lead screw tapping head can tap holes regardless of different threads, fine or coarse, small or large diameters, in the same head as each tap has its own lead screw, the lead which is identical with the tap.

The individual lead screw tapping head is built with all the necessary safety features to prevent tap breakage from the tap bottoming or striking the solid surface where a hole has not been drilled. In such cases, the tap holder travels backward while the lead schew travels forward. When the lead screw is reversed, the tap holder automatically returns to its original position. This feature eliminates the possibility of damaging the lead screw, lead screw nut, or the interior of the head. The automatic feature also removes a burden from the operator as he knows the tap is in the proper position when the next piece is placed in the fixture. The lead screw threads are precision ground after hardening; the lead screw nuts are bronze and can be replaced.

Two types of tapping units have been mentioned. A lead screw tapper must be used when it is necessary to have a class 3 or 4 thread, and when a large number of holes are to be tapped requiring more horsepower than is available on a cam feed unit. A cam feed unit with a reversing motor and control can be recommended when the thread is of class 1 or 2. The difference in performance of the two units is the lead screw, conducive to producing an accurate thread. The cam feed unit is fitted with a tension or compression type tap holder and depends on the tap for the lead.

Incorporation of high-speed drill units has aided important production increases in automotive applications such as this.

Use of Element Time Data for Effective Tool Design

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While considerable advance has been made in the development of tools for insuring the accuracy of the piece, there are many opportunities for improvement and development in tool design from the viewpoint of increasing production.

To put this another way—tool designers do an admirable job of designing a tool to insure interchangeability in the design of a product, but they could do much more from the standpoint of *assisting* the machine operator to quickly and *economically fabricate* the piece.

There are two general sources for tool estimating information, neither of which is either sufficiently detailed or specific enough to enable adequate modifications in design or appraisal of the savings through increased production that would result from these modifications.

Inaccuracy of Tool Estimates

In the checking of tool estimates we usually find that they are based on either one or both of the following systems:

1. Those figures which are gleaned from the cost system in use.
2. Those facts and figures which are based on general knowledge, that is, what the tool designer thinks will be the cost and production resulting from his design.

There are noticeable weaknesses in both of these sources of information. The most pronounced defects in the information obtained from these systems include:

1. They are based on history, that is, past performance. It is difficult for anyone to remember the external conditions that affected the results. For example, no one can remember the operating conditions that prevailed in the shop three months ago. This is apparent when anyone goes back over the cost of production records when the same part has been run several times in the last year. The result can vary 50 percent from the average, and we well know that this is not caused by the tooling.
2. Practically all data are collected by a clerk in one of the office departments who is not technically minded enough to make the proper classifications in such a way that these data can be readily used by a tool designer.
3. As a correlation to 2 above, such systems are based on a paper work routine. It has been our experience that most concerns are careless in the handling of the details necessary in order to give both accurate and useful information, on costs and production. Descriptions of the work, order number, time taken, etc., are at times carelessly reported and copied. Time on one job is erroneously charged to another and so on.

Element Time Structure

To overcome these difficulties and, at the same time, to furnish both the line and the staff departments of an organization with accurate and understandable data and information—we industrial engineers adopted what we call "element time data." Our firm has been using element time data for over thirty years. It is not a recent development by any means. It was developed as a basis for methods analysis and rate setting. Its use in tool design is a by-product of the work in methods analysis.

All machine design is based on the practical application of a series of fundamental mechanical movements. Any design, whether it is a jig, fixture, part or product has as its function the guiding of some forming tool to produce a certain shape, contour, supporting section. In brief, a designer looks first to the purpose of his design and employs a series of mechanical and guiding movements to produce the final object of his design.

We do exactly the same thing with element time data. We list, classify and arrange in tables every possible movement of the machine or the hand. In fact, all element time data consist of four major classifications. They are:

1. All movements of the machine such as:
   - a. adjust to cut
   - b. Return from cut
   - c. Rapid traverse
   - d. Index
   - e. Change speed
   - f. Change feed
   - g. Position-hand-table
2. All movements of the cutting or forming tools such as:
   - a. Slab mill
   - b. Face mill
   - c. End mill
   - d. Face
   - e. Turn
   - f. Drill
   - g. Bore
   - h. Ream
   - i. Tap
3. All movements of the hand in loading the machine such as: loading and removing the piece, locating and clamping, measuring.
4. All movements connected in assembling such as: fastening one part to another—to form a mechanism by various types of fasteners from common bolts and nuts on up to various types of welding. Similarly the fastening, and attaching of one mechanism to another.

We believe we can explain element time data by showing several examples. See Figs. 1, 2 and 3. Please note two things:

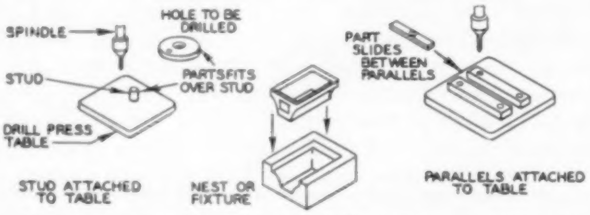
FIG. 1
STANDARD TIME DATA
HAND FEED DRILL PRESS MACHINES
HENRY-WRIGHT, ALLEN, DELTA

Description of Place and Remove and Handling Elements

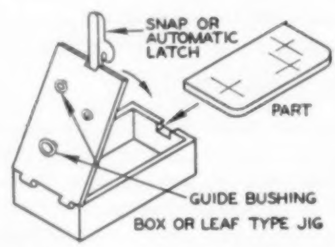
These standards cover all operations done on hand or foot feed drill presses of single or multiple spindle variety. The work is usually rested upon the table, or in a jig or fixture. The machining tables cover times for die cast, brass, bronze, cast iron, steel and malleable iron.

Place and remove includes picking up a piece from a tote pan beside the drill press table, placing and securing it in a fixture or upon the drill press table, releasing it from the fixture, removing it by a spring, blast of air, gravity or by hand and tossing or placing it in a tote pan beside the machine.

In general, place and remove falls into two basic divisions.



No. I covers the plain drill press table, parallels or a stud attached to the table, or a nest or open fixture which fits the contour of the part, or locates the part by previously machined holes or prodections.



No. II covers the use of a box or leaf type jig, which is essentially a square box having one or more locating points and a hinged cover which closes over the part and fastens with an automatic latch.

1. How these data are classified.
2. How the times for each of these elements or movements are recorded.

Advantages of Element Times

The advantages of using such element time data to assist tool designers in developing their art are as follows:

1. All data is technically classified; terminology follows the practices of designers. Anyone with mechanical perception can visualize the fabricating or assembling of the piece through the various movements covered in the element time tables.
2. These data are available in *advance* of the design. The tables or sections of them can either be furnished to tool designers or the tool design department can call on the industrial engineering staff to furnish them with the times for each of the alternates of design. From this information, a decision can be made by the designer as to which alternate is the most effective.
3. These data are the result of some 25 years of continuous time study in a number of metal working plants. They are the result of direct observations and checking so that they are bound to be more accurate than data secured from the analysis of cost and production records.
4. What is most important is that the same data the shop use to plan their work and to determine their operating efficiencies, are available to all staff departments interested in design. Furthermore, we have absolute coordination between the operating departments and the design departments through the medium of common data and similar information.

FIG. 2—STANDARD TIME DATA
HAND FEED DRILL PRESS MACHINES
Henry & Wright, Allen, Delta

Base Minutes Per Part — Place and Remove

All placing of parts done by hand. Removal of parts as described in tables.

No Fixture—Open Fixture—Nest—Parallels

Weight of Part Ounces	Type of Removal		
	No Grasp	Grasp and Release	Grasp and Place
1	.015	.021	.028
2	.016	.022	.030
3	.018	.023	.032
4	.019	.025	.034
5	.020	.026	.036
6	.022	.027	.038
7	.023	.029	.040
8	.025	.030	.042
9	.026	.031	.044
10	.028	.033	.046
11	.029	.034	.048
12	.031	.035	.050

For lever-type clamp, add .015 Min.
For extreme deviations from square shape, add

Ratio of length to width	Additional minutes
4:1	.002
5:1	.004
6:1	.007
7:1	.011

For restricted and positioning — add .009 Min.
For square or oblong pin, or more than (one) round pin — add .007 Min.

Fig. 3
STANDARD TIME DATA
HAND DRILL PRESS MACHINES
Henry-Wright, Allen and Delta

Base Min. to Shift Part from Hole to Hole or Spindle to Spindle and Misc. Handling

NO FIXTURE BASE MIN. PER HOLE			WITH FIXTURE BASE MIN. PER HOLE		
Weight of Part in Oz.	Move Hole To Hole	Move Spindle To Spindle	Wgt. Part and Fix. in Pounds	Move Hole To Hole	Move Spindle To Spindle
0- 2.0	.003	.009	1- 5	.006	.015
2.1- 4.0	.003	.010	5.1-10.0	.008	.016
4.1- 6.0	.004	.011	10.1-15.0	.010	.018
6.1- 8.0	.004	.012	15.1-20.0	.012	.020
8.1-10.0	.005	.013	20.1-25.0	.014	.022
10.1-12.0	.005	.014	25.1-30.0	.016	.025

Factor for turning part or fixture 90 deg. or more = 1.45

DISTANCE FACTOR FOR HOLE TO HOLE

DISTANCE (IN.)	FACTOR
0 - ½	.0
17/32 - 1½	1.0
1 17/32 - 2½	1.1

BUSHING LOOSE FIT IN JIG

Base Min. Per Hole .032

OIL TOOL ON SPINDLE WITH BRUSH

No. of Spindles	1	2	3	4	5	6
Base Min. Per Operation	.028	.032	.035	.038	.042	.046

BLOW OUT FIXTURE WITH AIR HOSE

Base Min. Per Operation .045

HANDLING TOTE PANS

Part Wgt. In. Oz.	Base Min.	Part Wgt. In. Oz.	Base Min.	Part Wgt. In. Oz.	Base Min.
0- 2.0	.001	10.1-14.0	.003	22.1-26.0	.006
2.1- 6.0	.002	14.1-18.0	.004	26.1-30.0	.007
6.1-10.0	.002	18.1-22.0	.005	....	...

FIG. 4—STANDARD TIME DATA

HAND DRILL PRESS MACHINES
HENRY-WRIGHT & ALLEN

Base Minutes Per Hole — Drilling Brass and Die Cast Zinc

RPM	2500	2500	2500	2500	2450	2030	1740	1520
FEED (IN.)	.005	.007	.008	.0095	.0105	.012	.0135	.015
DRILL SIZE								
Depth of Hole	57-45	44-27	26-5	4-1	A-H	I-Q	R-W	X-Z
1/16	.005	.004	.003	.003	.002	.003	.003	.003
3/32	.008	.005	.005	.004	.004	.004	.004	.004
1/8	.010	.007	.006	.005	.005	.005	.005	.005
5/32	.013	.009	.008	.007	.006	.007	.007	.007
3/16	.015	.011	.009	.008	.007	.008	.008	.008
7/32	.018	.013	.011	.009	.008	.009	.009	.009
1/4	.020	.014	.012	.010	.010	.010	.011	.011
9/32	.023	.016	.014	.012	.011	.012	.012	.012
5/16	.025	.018	.016	.013	.012	.013	.014	.014
11/32	.028	.020	.017	.014	.013	.014	.015	.015
3/8	.030	.022	.019	.016	.014	.016	.016	.016
13/32	.033	.023	.020	.017	.016	.017	.018	.018
7/16	.035	.025	.022	.018	.017	.018	.019	.019
15/32	.038	.027	.023	.020	.018	.020	.020	.020
1/2	.040	.029	.025	.021	.019	.021	.022	.022
9/16	.045	.032	.028	.023	.022	.023	.024	.024
5/8	.050	.036	.031	.026	.024	.026	.027	.027
11/16	.055	.040	.034	.029	.026	.029	.030	.030
3/4	.060	.043	.037	.031	.029	.031	.032	.032
13/16	.070	.053	.040	.034	.031	.034	.035	.035
7/8	.075	.057	.043	.037	.034	.036	.038	.038
15/16	.080	.060	.047	.039	.036	.039	.041	.041
1	.085	.064	.050	.042	.038	.042	.043	.043
Min/Point	.002	.002	.003	.003	.004	.005	.006	.006

Tool Adjust	Min. Per Hole
Break through holes	.009
Blind Holes	.005

Combination Drill & Countersink

Depth of C' sink	Additional Min. Hole
1/32" - 1/16"	————
5/64" - 1/8"	————

"Minutes per Point" is to be added to all operations where the drill runs through a guide bushing and engages a flat surface. It will not be allowed where the drill starts at the bottom of a hole drilled by a larger drill, or where the hole has been spotted in the molding of the part.

"Tool Adjust" will be allowed for each hole drilled. The "Minute per Hole" value will be either for "Break Through Hole" or "Blind Hole."

Illustrations

The following examples selected to illustrate time element data are of simple applications. We have done this with a purpose. After all, complicated designs are nothing more than a collection of simple applications joined together for one final objective. We have also centered our discussions on simple illustrations because our element time data are classified by these simple applications of design practices.

It may seem that the time applying to each of these illustrations is very small. They are all in fractions of a minute. Do not be misled into thinking they are minor or unimportant. There are millions of such movements in a day's work in the average shop. *Their accumulative effect is great.* To put this another way, the saving of 2/10 of a minute in one movement may be 25 or 35 percent of the time of the job.

When using these time tables to determine which type of design would be best suited to a particular operation, it would be necessary to list the sequence of steps to be performed by the worker when using the tool. The corresponding time values would be looked up in the time charts and the value in time determined. By adding the time for the various steps of work together, the total time for the operation would be determined. A comparison of these times for the different designs under consideration would enable a designer to select the one most economical to the company.

This selection would have to take into consideration the cost of the proposed fixture and compare this cost with the savings resulting from the use of the tool or fixture. Production quantities have a great bearing on the advisability of making new fixtures or altering old ones.

The effect of the design on the time required to set up the tool, jig or fixture in actual operation is important. Complicated tools requiring complicated set-ups should be avoided where possible. Unless the savings in operation or piece time are great, complicated set-ups serve to further increase cost. The only advantage to be gained in high set-up time must be in the reduction of time to make the part after the set-up has been made. The size of the lot, or quantity of pieces to be run should also be considered in determining how far to go in complicating the fixture. For short run jobs, fixture and tool design requiring a minimum of set-up time must be the prime consideration.

Fundamental Principles to Be Considered

There are a number of fundamental considerations before proceeding with the examples showing the effect on shop costs and how standard times were helpful in solving the problem. Some of these include:

1. Ease of handling the part in and out of the jig or fixture.

For example, consider parts located over studs. This circumstance varies according to the accuracy required. Wherever possible, the tool designer should strive for quick and positive location. If only normal accuracy is required, the fitting of parts to studs should be suited to easy handling. In terms of actual time on one part with a bore diameter of 4.920 inches—4.921 inches, there was no need indicated on the drawing to hold close tolerances between the milled surface and the bore. The time taken to tap piece and work it back and forth over a stud took 0.21 minutes. If the stud had been made to a free and easy fit, the time would have been 0.09 minutes, a 57.3 percent difference in time.

The length of the stud may also have a bearing on the time. The stud should not be longer than necessary for the accuracy needed.

2. The number of clamps or work-holding devices should be kept at a minimum consistent with the requirements for rigidity or accuracy.

In one of our client's plants we observed a radial drill fixture used to front and back-spot face a large cast iron part. The fixture was a trunnion type and provided 13 tail knobs for holding the part in place. If the worker used these 13 knobs, it would take 2.60 minutes to fasten the piece in place. It developed in actual operation that only three were necessary, requiring a time of 0.47 minutes. This represents a 55 percent saving in time which is substantial, besides, the cost of the other 10 tail knobs put on the fixture could have been saved.

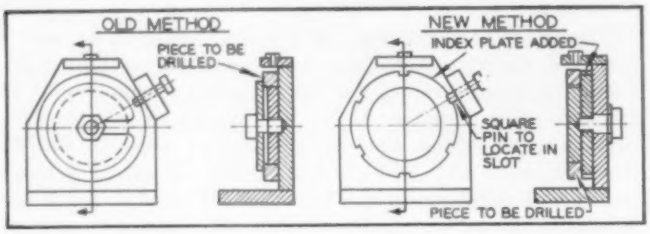
3. Universal jigs for small work to be drilled can serve a real purpose in reducing tooling cost as well as requiring less storage space and cost of tool delivery to the workman.

This uniform pattern of jigs become helpful to the drill press operators in doing their work. They should be of the quick-operating kind and can be so standardized as to require only minor additions to convert them from one job to another.

4. Standard or interchangeable bushings for all jigs are not always as economical as some people think they are.

Wrong lengths of bushings for proper chip clearance are used, and bushings are often in poor condition, thus affecting the accuracy of an otherwise good jig. In many cases, the holes are spot drilled, the bushing removed and then the hole finished, all requiring extra production time. This method has been found to be expensive and inaccurate and

Fig. 5



PART HELD WITH CAP SCREW AND "C" WASHER

Holes located by drilling first hole and then locating each (of 5) succeeding hole by loosening cap screw, rotate part to engage locating pin in drilled hole and tighten cap screw.

TIME—BASE MINUTES—PER PIECE

Place and remove part	.27 Min.
Drill holes 6 @ .11	.66
Index part 5 @ .17	.85
TOTAL	1.78 Min.

results in poor drilling practices, particularly where inexperienced workers are used.

5. The length of approach to cut in the case of milling fixtures.

We later show several examples of reducing the time required to cut by reducing the cutter approach.

6. Ease of cleaning.

Jigs and fixtures should be designed whenever possible to be self-cleaning. Locating surfaces may be raised and angular surfaces provided so that chips which accumulate will slide away from location points. Some fixtures may be made open so that when the piece is pushed into the fixture, the chips are pushed out.

Where Some Modification of Tools Resulted in Substantial Labor Savings in Operation

1. Drill Jig for Bearing Lock Nut

Two types of fixtures used for drilling six holes equally spaced in the periphery of a bearing lock nut are shown in Fig. 5.

The old method involved drilling one hole and then using this hole to locate the next through the use of an index pin. Parts were held in place over a stud and by a clamp using a cap screw.

In the new method, the part is held by the threads on an index plate, the threads cut undersize to allow for a slightly loose fit so that part can easily be placed and removed. Holes are located by index pin in slot in index plate.

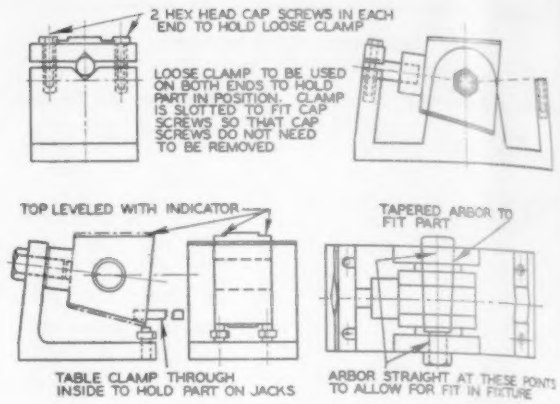
The time required to complete the operation under the old method amounted to 1.78 minutes, under the new method, 1.19 minutes, and resulted in a saving of 33.1 percent in time.

Under the old method, the threads in the hole of the part were sometimes burred due to the careless loading and unloading of the piece in the fixture, and excessive drill pressure. This necessitated the addition of a burring operation which was not required when using the new fixture. An additional 0.85 minutes, which has not been included in the above saving, was thus saved.

2. Milling Crosshead Shoe Bearing Key

Under the old method a simple fixture was used to hold the part as shown in Fig. 6. The feed used in this case was 1¼ ipm, due to the fragile or insecure method of holding the part; and even with this low feed rate a satisfactory

Fig. 6.



Old Method Cost—Minutes per Piece

P. and R. 2 @ .45	.90 Min.
Level and Indicate 2 @ 6.00	12.00
Cut (1¼ in. feed) 2 @ 3.90	7.80
Total	20.70 Min.

New Method Cost—Minutes per Piece

P. and R.	.95 Min.
Reposition	.55
Cut (6 in. feed) 2 @ .815)	1.63
Total	3.13 Min.

NEW METHOD—Self Locating

fixture—requires (1) loading and (1) repositioning to straddle mill both sides.

SAVINGS—BASE MIN.

Old Method	20.17
New Method	3.13

Savings $17.57 = \frac{17.57}{20.70} = 84.8\%$

job was not obtained. It was also difficult to get the cut equidistant from the center, making it necessary to later fasten the crosshead shoe bearings to the crosshead and finish turn as a subassembled unit.

In the new method, the part is held more securely in a self locating fixture. A feed of six inches per minute was obtained. Due to the tapered arbor for locating and holding the part from the center, the operation of finish turning the crosshead shoe bearings in the subassembled state was eliminated. This saved an additional 15 minutes beyond the 84.8 percent saving indicated in the sketch.

3. Turning Steel Tubes

Two examples are given: (See Fig. 7). Figure A shows the old method and Figure B the new method.

Under the old method (A) a 2 in. OD x 12 in. long x 1½ in. OD steel tube was turned concentric with the mill ID of the tube within 0.002 in., faced and chamfered on one end.

The following operations were required to accomplish this as follows:

1. Hand-center ID's of tube.
2. Place one end in soft two-jaw chuck and support the other end with a revolving center.
3. Turn the piece half-way, face and chamfer the end.
4. Remove piece, turn and rechuck the turned end, supporting the other end with the revolving center.
5. Turn the other half of the piece, break corner.
6. Remove piece from machine.

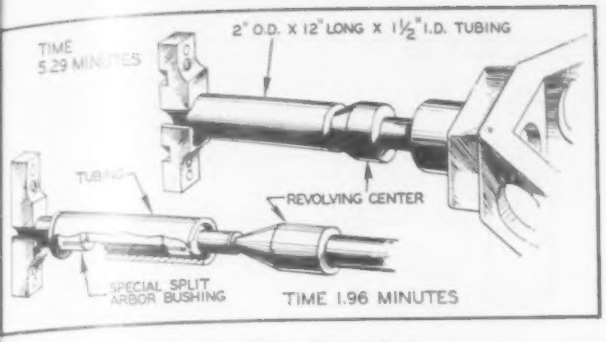


Fig. 7: A (left); B (right).

Under this method a line of demarcration was always visible where the turning operations met and the concentric tolerance was seldom obtained.

Referring to B, the new method involved the use of a split bushing arbor which would accommodate a large variation in the mill size ID of the tube. In this method, the tube was slipped over the arbor and the revolving center was forced against the end of the arbor to expand the bushing, at the same time, centering the piece and supporting the end of the arbor. The opposite end of the arbor is held in a regular chuck.

The piece is now turned complete and the ends faced and chamfered in one operation. The revolving center is then removed from the arbor releasing the split bushings and the piece is removed. *Concentricity is easily maintained* and the time to perform the operation is reduced by 63 percent. The time under the old method amounted to 5.29 minutes, while the time required for the new method is 1.96 minutes.

4. Grinding Arbor

At C in Fig. 8 is shown the type of grinding arbor used for finish plunge grinding bearing races. When using this arbor, the nut and washer had to be removed completely in order to place and remove the piece. The use of a "C" washer would not correct this condition because of the small size of the hole in the piece, which necessitated removing the nut anyway. It was impractical to reduce the size of the nut because of the center hole in the threaded end of the arbor.

The use of two arbors was also impractical as the grinding time was so short, and the tolerance close, and the grinding required the operator's attention at all times.

The modifications made for more effective use of this arbor, are shown at D. The arbor has been fitted with a knurled nut, the outside diameter of which is the same as the washer in C. The center section of the nut is counterbored so only several threads are left in engagement on the threads of the arbor. This change in design reduced the time for the entire operation by 15 percent. The old time was 0.80 minutes and the new time 0.68 minutes.

5. Bend and Emboss

In the original press setup with the stripper plate close to the die, the pieces were forced back into the die well while the punch was being withdrawn after the downstroke. This made it necessary for the operator to use a pick to remove the completed pieces from the die and resulted in a considerable delay in production.

Another design was developed with a longer punch and with the stripper plates placed in the sides of the die at a higher point. An air ejector made it possible to blow the pieces to a slide leading to the rear of the press, eliminating

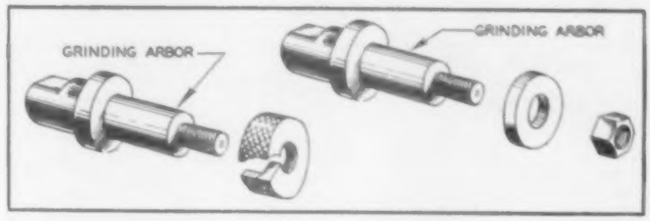


Fig. 8: C (left); D (right).

the need for hand picking the pieces from the die.

Element time values for both methods are given in Fig. 9, showing that the resulting savings from this modification in tools amounted to 46 percent.

6. Piece, Nick and Blank

In the original die set, the nicking punch was assembled with the blanking punch, and it was not possible to produce a satisfactory nick in the piece. In assembly, time was lost because of searching for the nick.

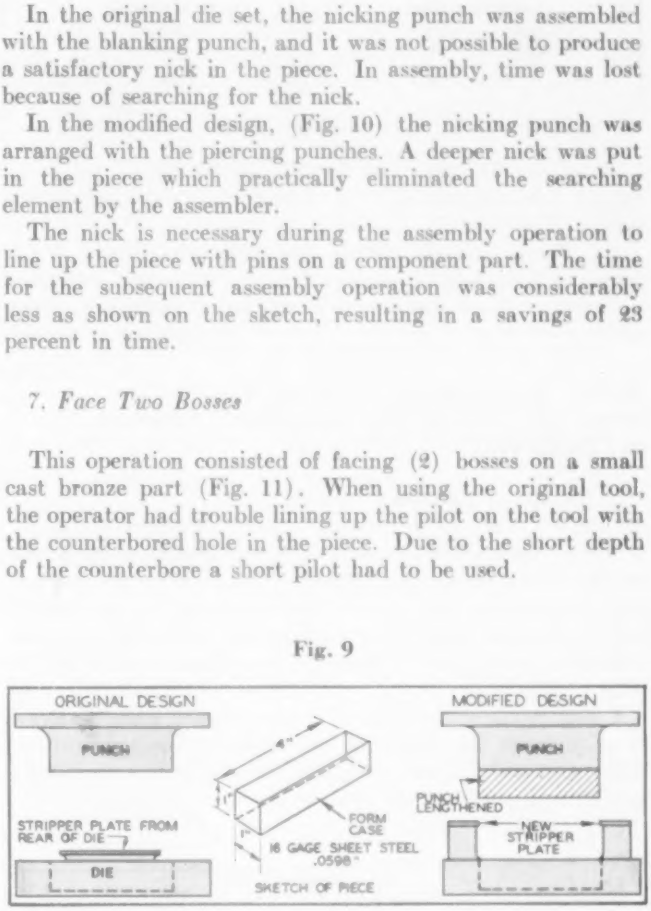
In the modified design, (Fig. 10) the nicking punch was arranged with the piercing punches. A deeper nick was put in the piece which practically eliminated the searching element by the assembler.

The nick is necessary during the assembly operation to line up the piece with pins on a component part. The time for the subsequent assembly operation was considerably less as shown on the sketch, resulting in a savings of 23 percent in time.

7. Face Two Bosses

This operation consisted of facing (2) bosses on a small cast bronze part (Fig. 11). When using the original tool, the operator had trouble lining up the pilot on the tool with the counterbored hole in the piece. Due to the short depth of the counterbore a short pilot had to be used.

Fig. 9



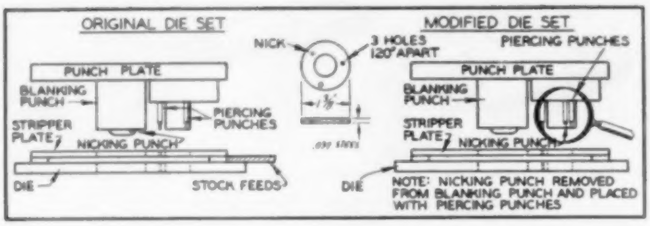
TIME FOR OPERATION

	(using old die) ORIGINAL METHOD	(using new die) NEW METHOD
Base Time	.025	.025
Allowance for area of piece	.010	.010
" " " adhesion	.003	.003
" " " one way only	.003	.003
" " " stripper	.002	.002
" " " contoured slots	.004	.004
" " " pick to remove	.050	—
" " " air reject	—	—
" " " handling	.009	.009
" " " arrange pcs. on press	.002	.002
TOTAL MINUTES	.108	.058

46% SAVINGS

NOTE: The base time is used on all jobs and is the time for the complete operation on the simplest job. Additional allowances are made for special conditions as shown above.

Fig. 10



Pierce, Nick and Blank

BASE MINUTES FOR OPERATION—.0106 MINUTES

Operation: Pierce 4 holes, nick and blank
Machine: Punch Press

By having the nicking punch with the piercing puches as shown above it is possible because of the support under the punch to punch a deeper nick into the piece which will eliminate a searching element by the assembler which amounts to .04 base minutes.

OLD METHOD		NEW METHOD
Blanking	.0106	.0106
Assembly	.1640	.1240
Total	.1746	.1346 = 23% Savings

A longer pilot was put in the tool to locate from the tapped hole, and the operator had no trouble lining up the tool.

As shown on the sketch, the time required for this operation originally amounted to 0.157 minutes, and after the change, the operation took only 0.108 minutes to complete, resulting in a saving of time of 31.2 percent.

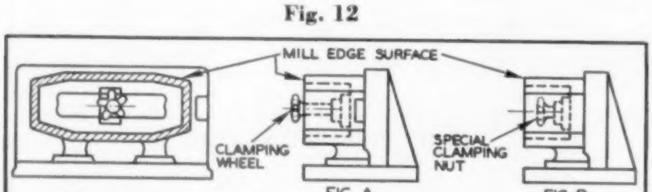
Where Modification in Design Resulted in Improved Cutting with Consequent Increase in Production

8. Change of Clamping Method

Due to the nature of the part, it was necessary to mount the piece on an angle plate fixture (Fig. 12). On the original design, clamping was accomplished by the use of a small clamping wheel projection, which made it necessary to use a smaller cutter and traverse around the periphery of the piece.

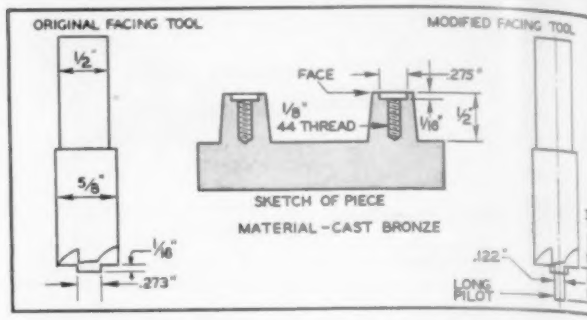
A shorter clamping nut and special wrench were designed so as to lower the clamping mechanism below the surface. This permitted the use of a larger face mill and milling was accomplished by one straight pass across the surface.

Fig. 12



ELEMENT TIMES	Figure A FEED 10"/M SMALL CUTTER AROUND PERIPHERY MINUTES	Figure B FEED 38"/M LARGE CUTTER STRAIGHT ACROSS MINUTES
Place and remove	.120	.092
Tighten	.264	.210
Adjust machine to cut	.070	.070
Mill cut	.310	.116
Clear cutter	.049	.052
TOTAL TIME	.813	.540
TIME SAVINGS PER PIECE		.273
% SAVINGS		34%
% INCREASE IN PRODUCTION		51%

Fig. 11



DETAIL OF TIME IN MINUTES

	(using old tool) ORIGINAL METHOD	(using new tool) NEW METHOD
Place and remove to jig	.040	.0400
Locate under tool	.029	.0045
Face (1 boss)	.020	.0200
Turn part and jig	.015	.0150
Locate under tool	.029	.0045
Face (2nd boss)	.020	.0200
Gaging allowance	.002	.0020
Oil spindle (every 25 pcs.)	.002	.0020
TOTAL BASE MINUTES —	.157	.1080

SAVINGS IN TIME — 31.2%

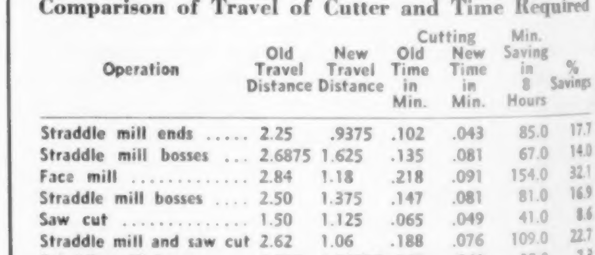
The feed used on the smaller cutter was 10 ipm. The feed used on the larger cutter was 38 ipm.

The saving in time amounted to 0.273 minutes or a 34 percent saving in time with a corresponding 51 percent increase in production.

9. Some Examples of Reducing Cutter Approach

The importance of designing a fixture to take advantage of the shortest cutting distances on some classes of milling machine work are illustrated in Fig. 13.

Fig. 13



Comparison of Travel of Cutter and Time Required

Operation	Old Travel Distance	New Travel Distance	Cutting Old Time in Min.	Cutting New Time in Min.	Min. Saving in 8 Hours	% Savings
Straddle mill ends	2.25	.9375	.102	.043	85.0	17.7
Straddle mill bosses ...	2.6875	1.625	.135	.081	67.0	14.0
Face mill	2.84	1.18	.218	.091	154.0	32.1
Straddle mill bosses	2.50	1.375	.147	.081	81.0	16.9
Saw cut	1.50	1.125	.065	.049	41.0	8.6
Straddle mill and saw cut	2.62	1.06	.188	.076	109.0	22.7
Straddle mill bosses	1.375	1.06275	.063	.048	35.0	7.3
Straddle mill bosses	1.125	1.00	.09	.08	10.0	2.8
Straddle mill bosses	2.05	.875	.10	.042	71.0	14.8
Straddle mill shaft	1.875	1.5625	.085	.071	16.0	3.3
Straddle mill and saw cut	2.375	1.19	.170	.085	141.0	29.4
Straddle mill bosses	2.125	1.50	.097	.069	39.0	8.1
Straddle mill bosses	2.06	1.312	.093	.060	43.0	9.0
Straddle mill bosses	2.5625	1.5625	.116	.071	54.0	11.3
				TOTALS	946.0	14.1

14 jobs on 8 Hour Days Basis—6720.0 Minutes
% SAVINGS — 14.1%

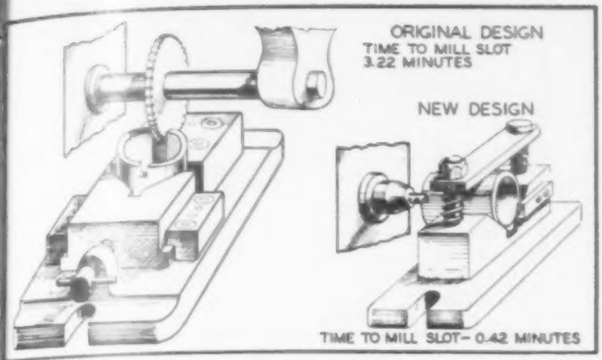


Fig. 14: E (left); F (right).

In order to illustrate this principle, at A, the piece is held in a vertical position and the direction of cut is horizontal. This required a longer cutting distance than at B, where the piece is held horizontally in the fixture and the center line of the cutter is in a line with the center of the bosses to be milled.

A chart is given listing 14 different jobs where changes of design resulted in reduced cutter approach.

A comparison is made of:

1. Old and new travel distance
2. Old and new cutting time
3. Savings in an eight-hour day, percentagewise and in minutes.

Changes in the fixture design on the jobs listed resulted in a total saving of 946.0 minutes per 8 hour day or a net saving of 14.1 percent of the total time.

10. Redesign of Fixture for Milling Slot

A completely different design of fixture was the answer to a slot milling problem. In the original method, a special vise-type milling fixture was used, (see E, Fig. 14) for holding thin wall pieces and milling slots across the end. A plain six-inch milling cutter was used, mounted on an arbor in a horizontal milling machine. An approach to cut distance of 1.73 inches was required when using this cutter and the total travel of the table at machine feed amounted to 4.43 inches. Due to the thin wall section of the piece, a low feed of $1\frac{3}{8}$ ipm was required in order to avoid too much pressure on the piece which would cause the machine table to jump, as one tooth of the cutter would run off of the work before the next tooth engaged. Sometimes the cutter caught the work and pulled up the piece in the fixture. Climb-milling was tried without success.

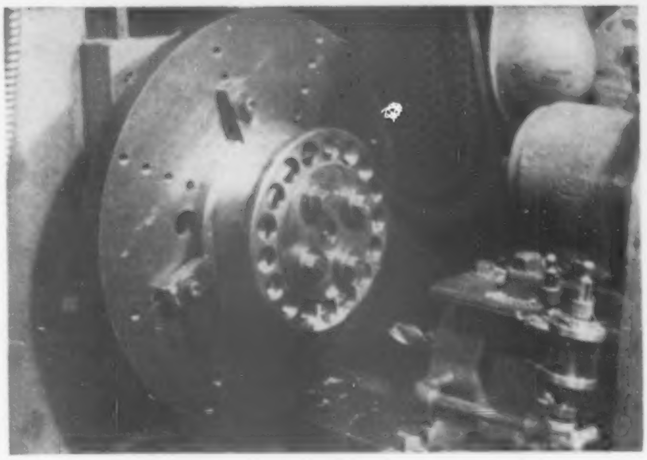


Fig. 15

A new fixture (See F, Fig. 14) was designed so as to use a half-inch end mill mounted in the spindle of the machine. Using this fixture, the cutter approach was reduced to 0.250 inches and the total cutting distance to $1\frac{1}{2}$ inches, while an increased machining feed of $3\frac{1}{2}$ ipm was obtained.

The old time required to mill the slot was 3.22 minutes, compared with a new time of 0.42 minutes with a resulting saving of 87 percent in time. The handling time and machine manipulation time was approximately the same with either fixture.

Where Change in Design Reduced the Time to Place and Remove the Work in the Fixture

11. Drilling Fixture on Automatic

Fig. 15 shows a method of clamping a piece into the fixture for drilling a number of holes using an automatic drilling machine. Four bolts and washers were positioned, tightened and assembled for every piece. As the drilling was completely automatic except for loading and unloading, the operator was required to run other machines during the time the machine was drilling. The work elements consisted of the following:

a. Place piece and fixture
b. Place top plate, four bolts and washers
c. Tighten
d. Start machine

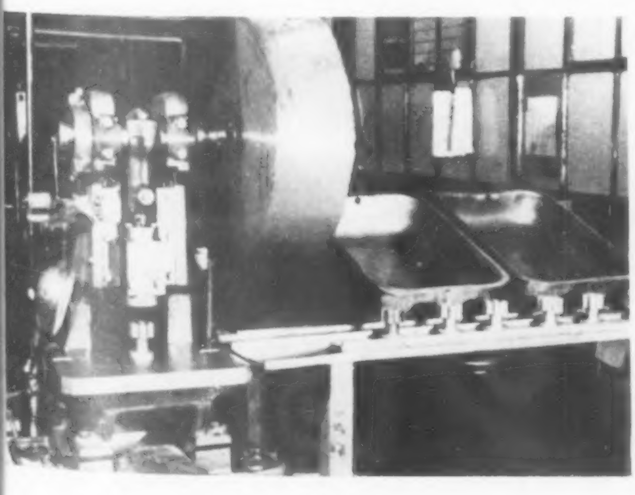


Fig 16

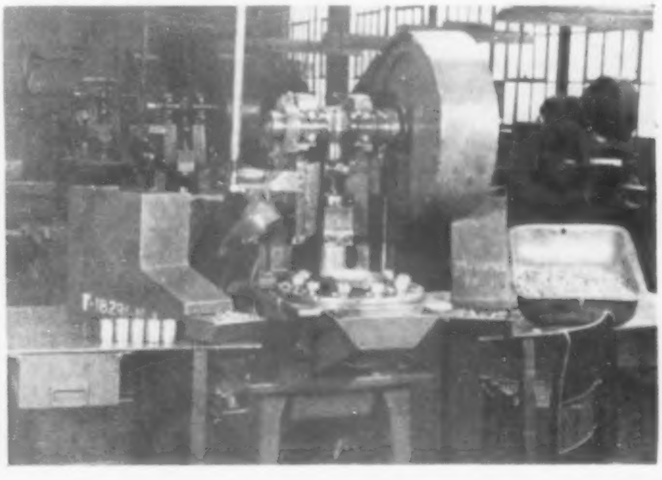


Fig. 17

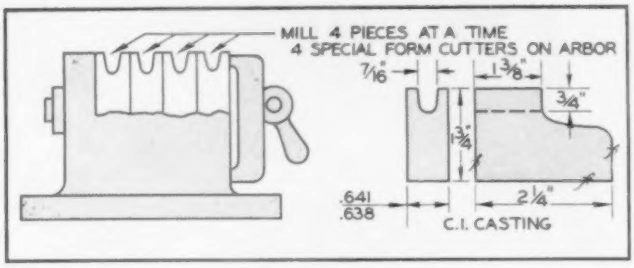


Fig. 18

After the machine has completed the actual drilling the following work was done by the operator:

a. Loosen four bolts

b. Remove four bolts from washers

c. Remove top plate

d. Remove piece

In changing the operation, hole was drilled and tapped in the center of the fixture. An Allen head bolt and a "C" washer were used to hold the top plate and part of the fixture.

The old time required for the operator to do his work amounted to 1.55 minutes. After the fixture was changed, the new time for the same operation now takes 0.63 minutes and results in a saving in time for this operation of 59 percent.

Re-Analysis of Entire Work Place and Redesign of Fixture to Reduce Number of Workers Required

12. Assembly of Bearing and Cages

This operation was selected to show the effect of a complete re-study of the entire work place and re-design of other fixtures to reduce the number of workers required. In Fig. 16 the old work place layout for assembling bearings and cages is illustrated. The assembly bench was designed and built so that three girl operators could work as a unit. Two girls would assemble the rollers or pins in the fixtures working at the work bench. These girls would then slide the fixture along the back of the bench to a girl stationed in front of the press. The girl in front of the press would assemble the end plates and set the bearing or cage together by pushing on the foot pedal and operating the press. She would then remove the bearing or cage from the fixture and place them in a tote box at her left. The fixtures would then be slid back along the table to be re-filled by the other two girls.

The reason for this method of assembly was to increase the production per press. Actually, there was more than enough press capacity and the tool designer apparently lost sight of the fact that labor cost was a more important consideration than output per machine.

Fig. 17 illustrates the new method of assembling bearings and cages. One operator assembles the rollers and pins into the fixture and then puts on the end plates. The dial mounted in the press revolves continuously and the press automatically trips when the bearing or cage comes into the position under the ram. After staking the operator removes a finished bearing or cage from the fixture and drops it down the chute (shown in front of dial plate) to the tote pan at the rear of the press.

The cost of making up the dial assembly fixture was little more than the original amount spent to design and build the work bench for the three operators. The new method

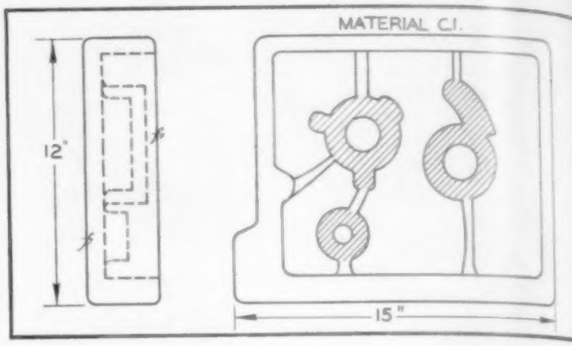


Fig. 19

reduced the labor time required 64 percent. A slight lo[ss] in volume of output per press was encountered when goi[ng] from three operators to one operator. In other words, one operator turns out almost as much work as three operators did before the change, resulting in a saving of about 6[0] percent.

Importance of Shop Follow-up by Tool Design Department

13. Use of Fixture on Wrong Machine

The fixture designed for this job calls for milling four pieces at a time using four formed tooth HSS cutters mounted on an arbor. With four HSS cutters a speed of 7[?] sfpm and a feed of 5.3 ipm was obtained in the shop. By using only one cutter a speed of 175 sfpm and a feed of [?] ipm was used satisfactorily. Fig. 18.

In other words, when milling four pieces at a time as called four by the fixture, a production of 180 pieces per hour was obtained. Using the same fixture but milling only one piece at a time resulted in a production of 285 pieces per hour. The question here is why should not four cuts be made as fast as one cut? The job was routed to a machine with insufficient power.

This is an example where proper use is not being made of a fixture. There should be a closer coordination between the tool design department and production routing to the shop so as to protect their interest as well as to know what is going on.

Use of Standard Data to Determine Whether or not Fixture Should be Made

14. Milling Bosses—Table Versus Fixture

There are some types of work where there is not much advantage in building a fixture. Most tool designers are aware of many such applications. The use of standard time data to estimate both methods will give the answer to the question of whether or not to design a fixture.

The illustration shown in Fig. 19 has been taken from actual practice, and by applying standard element times to both the fixture method and the table method, it was determined cheaper to dispense with the fixture. A 50 percent decrease in handling was shown to result by the application of standard time data. This was validated in actual practice.

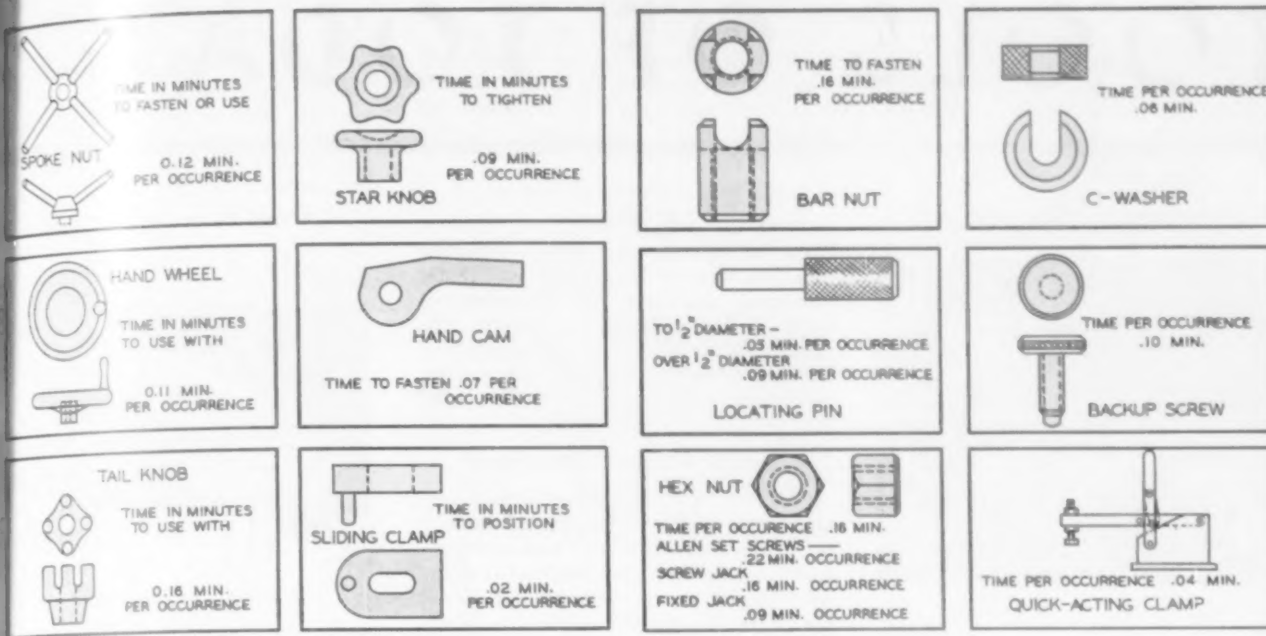


Fig. 20

Some Examples of Handling Times for Component Parts of Fixtures

15. Time for Component Parts

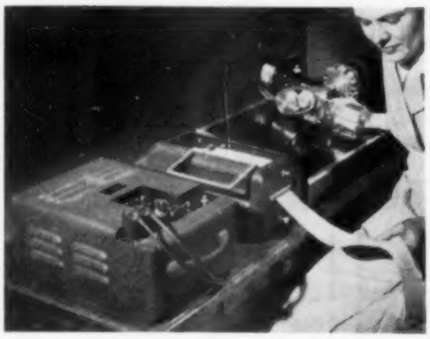
Some representative time values for the use of various simple clamping or fastening devices in actual production are given in Fig. 20. For the convenience of the tool engineer when referring to these charts, total times are given. For example, on the spoke nut, the time of 0.12 minutes per occurrence is the sum of the various element times required for use, such as "grasp", "tighten", and "grasp" and "loosen".

An examination of these values shows that quick acting clamps are the quickest for shop use. Various other devices require a time ranging from 0.07 minutes to 0.22 minutes shop use.

Once tools are made, it is expensive to change them. One of the purposes of this article is to show what may be expected of the tools in terms of actual production. By means of such analysis, the tool engineer may make many modifications and changes in the design before the tools are made. Element time data are practical since they are based on actual studies made of good shop performance. The system enables the tool engineer to accurately estimate expected production and the results predicted can be obtained. Its use will result in improved coordination between the tool design department and the shop departments and tool engineer to present accurate estimates of tooling costs production engineering departments. It will enable the and expected results to management.

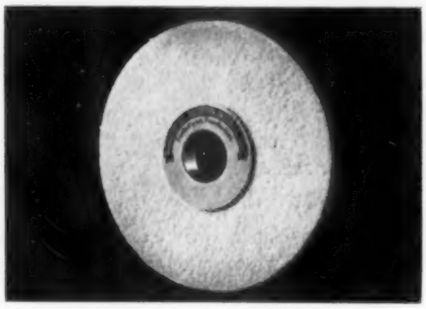
TOOLS OF TODAY

Universal Analyzer



The Brush Development Company will exhibit the BL-320 Analyzer which, when used with the BL-201 direct inking oscellograph and one to four strain gages, records in micro-inches the compression or elongation of a specimen under test. To be demonstrated. Also exhibited will be surface analyzers, and amplifiers. Booth No. 33. **T-4-209**

Grinding Wheels by Macklin



The Macklin Company, booth No. 943, will exhibit a complete line of grinding wheels, in all sizes and shapes and in various grain sizes and bonds. In the exhibit will be Macklin grinding wheels specifically designed to give a satisfactory and cost saving result for both production and tool room grinding operations. **T-4-153**

Trimming Die

A Brehm trimming die, set up and operating in a conventional punch press, will be featured in the exhibit of Steel Products Engineering Company, booth No. 431. **T-4-153A**

Contour Measuring

A "Probograph" automatic contour measuring instrument will be exhibited by Industrial Scientific Company. Also shown will be a photographic display of the company's products. Booth No. 34. **T-4-153B**

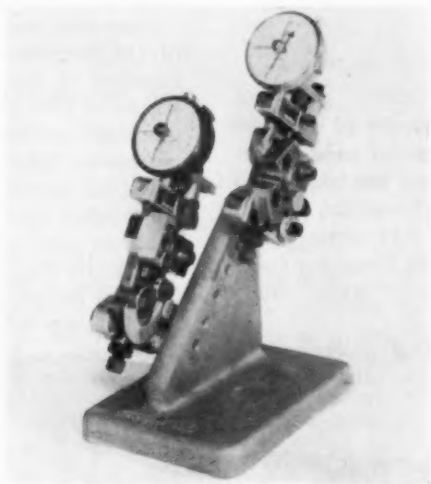
Air Motors

Air motors for converting standard machine tools to automatic and semi-automatic operation will be exhibited by the Bellows Company, booth No. 802. Also, among air-operated devices, will be vises, rotary tables, cylinders, valves, and impact presses. **T-4-153C**

Screw Thread Analyzer

Featured by the Johnson Gage Company, will be the Screw Thread Analyzer, a combination of two separate purpose comparators—the Model BG ring-snap thread comparator and the Model CN roll-snap thread comparator. Booth No. 1051.

The former gives a composite reading of all the thread elements collectively, thereby revealing the exact condition



of "assemble-ability" of the thread, while the latter gives check of pitch diameter only in a single element. Thus, the exact fit of the thread with its components, and accuracy of the several elements—pitch diameter, lead, roundness, and straightness—are all quickly and accurately revealed. **T-4-31**

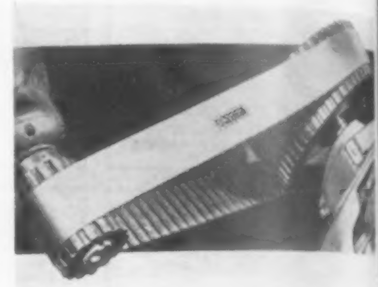
Press-Vac Safety Feeders

F. J. Littel Machine Company will feature press safety equipment for punch presses which, together with an air-blast valve, keeps the operator's hands out of the danger zone and further ejects the finished part from the die. Booth No. 6. **T-4-31A**

Setup Accessories

A complete line of accessories for machine tool setups and mountings will be exhibited by Standard Shop Equipment Company, booth No. 1157. **T-4-31B**

Positive Grip Flat Belt

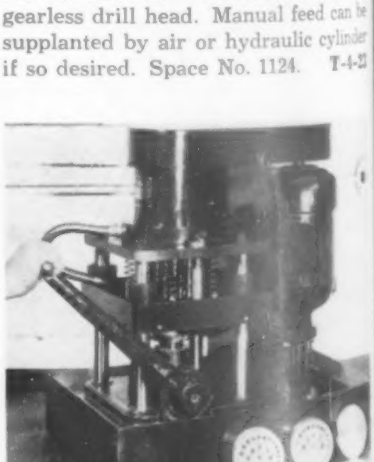


A flat endless belt with teeth that engage axially-grooved pulleys—the Gilmer "Timing Belt"—furnishes tool engineers with a belt drive said to positively control slip. The pulling element of steel cable provides extreme tensile strength, reducing stretch to zero, and making efficient operation certain on fixed center drives. A flexible Neoprene body encases the cables and protects against oil and heat. Speeds range from inches-per minute to 10,000 fpm; motor loads from 1/20 to 500 hp. L. H. Gilmer Division, U. S. Rubber Co., booth No. 748. **T-4-2[illegible]**

Jig Driller

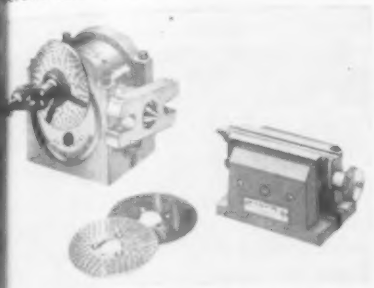
Exhibited among other equipment by Zagar Tool, Inc., will be the Zagar Jig Driller, a motorized unit which combines the functions of a pump jig and drilling machine. The tool illustrated is set up to drill 32 holes in aluminum drill stands, using this unit.

The tool, which meets the need between single spindle and special purpose drilling machines, consists of a 4-post pump type jig on which is mounted a standard motor driven Zagar gearless drill head. Manual feed can be supplanted by air or hydraulic cylinder if so desired. Space No. 1124. **T-4-2[illegible]**



Attachment by Marvin

A Dividing Head, featured by the Marvin Machine Products, Inc., provides for a wide range in the number of divisions available to meet specific requirements. It is designed for dividing operations in layout, squaring shafts, fluting taps, gear cutting, splines, reamers, hex screws and cams.



The complete Marvin line of machine tool attachments includes a vertical mill, a slotter, a rotary table, and the Marvin Micrometer Boring Head. These tools will all be shown in operation, booth No. 1010. T-4-107

Air-Draulics

Air and hydraulic equipment, including cylinders, pumps, valves and controls will be displayed by Logansport Machine Company, Inc., booth No. 707. T-4-107A

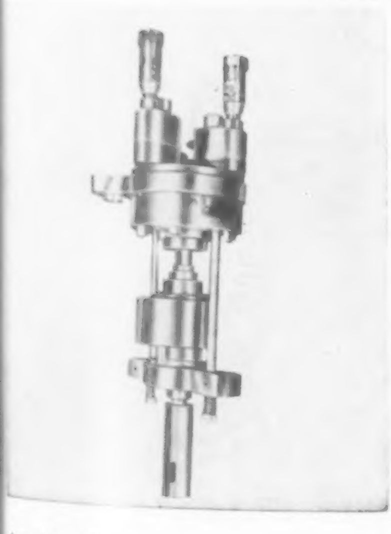
Press Safety Device

Walsh Press & Die Company, booth No. 716, will exhibit safety devices for punch presses; also, electric testing equipment for location of defects in crankshafts and machine components. T-4-107B

Adjustable Tapping Heads

Errington Mechanical Laboratory, Inc., will exhibit an adjustable Tapping Head said to offer many advantages never before available.

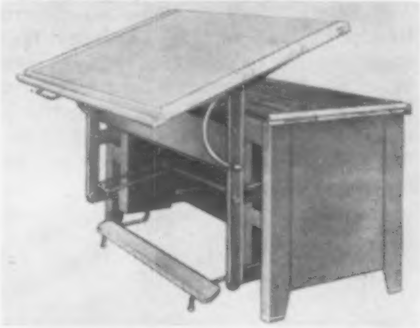
All parts are fully enclosed for pressure lubrication and protection, with non-slip positive clamping on all adjusting members. The Errington Adjustable Tapping Head is supplied with three spindles, for equal adjustment in line, and 3, 4, 5, or 6 spindles for equal adjustment on bolt circles. Booth No. 554. T-4-33



Tool & Diemakers Files

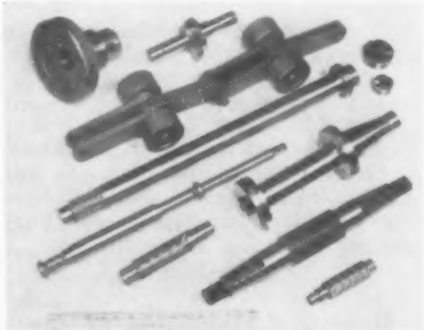
Exhibiting in booth No. 1153, Grobet File Co. of America, Inc., will show a complete line of Swiss-type tool and die-makers files; also countersinks, cutters and form tools. T-4-33A

Auto-Shift Drawing Table



The Hamilton Auto-Shift drawing table, space No. 713, is an advanced idea in drawing table design. The drawing surface is instantly adjusted to any convenient working height and slope by merely stepping on a pedal. Finger tip pressure then sets the board at desired height, and pressure on a lever swings the board to any angle. One can work comfortably on any part of the drawing while seated or standing. T-4-57

Free Machining Steel



Joseph T. Ryerson & Sons, Inc., will feature Rycut, a free machining alloy steel first instroduced in the Cleveland market. Typical parts made from this steel are illustrated. Space No. 334. T-4-80

The Iron Age

Iron Age is the "national metalworking weekly" that covers not only domestic but world trends in industry. Booth No. 210. T-4-80B

Continuous Pilot C'bores

Putnam Tool Company, booth No. 1119, will display a line of cutting tools including end mills, continuous pilot counterbores and spiral fluted chucking reamers. T-4-80C

Hydraulic Power Units

Vickers, Inc., booth No. 239, will have an extensive display including power units, fluid motors, hydraulic controls, valves and cylinders. T-4-80D

Ceramic Surface Plate

Among the many interesting exhibits at the ASTE Cost Cutting Exposition will be a display of Ceramic Surface Plates, by the Norton Company,—booth No. 409—here shown in combination with precision gages which will also be on display in other parts of the Auditorium. T-4-44

Wheels for Carbide Grinding

Precision Grinding Wheel Co., Inc., will exhibit Lotens Grinding Wheels, which have been developed expressly for grinding of carbide tools. For example, a silicon carbide wheel, by this company, is made in a special "cavity clearance" structure which applies to both roughing and semi-finishing operations. These wheels will be exhibited booth No. 1046. T-4-44-A

Cams and Tool Components

Morton Machine Works will exhibit an extensive line including roll, single, and double cams; also jig, fixture and tool room accessories. Booth No. 437. T-4-44B

Oils and Lusol Coolant

The F. E. Anderson Oil Company, booth No. 422, will feature Lusol, the recently developed coolant said to permit higher production rates than formerly possible. This coolant, which will be exhibited along with other Anderson products, improves finishes, lengthens tool life, improved working conditions and cuts costs on machining operations. T-4-44C

Grinding Fixture

Featured by Madison Mfg. Co., space No. 513, will be the Madison Grinding Fixture, originally designed for regrinding Madison blades and since modified to handle the every day run-of-the-shop grinding jobs. T-4-67

Internal Grinding Wheels

Featured as the "latest development in abrasive products" is the line of V1 Bond wheels for internal grinding, to be introduced by The Carborundum Company at the ASTE Show. These wheels, which are said to provide longer life and increased production because they grind more pieces per wheel, may be seen at the Carborundum Company exhibit, booth No. 1101. **T-4-171**

Giant Surface Plates

Herman Stone Company is now producing granite surface plates in sizes up to 8x16 ft. and weighing up to 25 tons. These non-warping plates are said to be made to the same accuracy as the 24 x 6 in. size, which is finished to accuracy of 0.00005 in.

In addition to a line of granite surface plates, Herman Stone will have enlarged photographs showing interesting applications of these and other granite products. Booth No. 15. **T-4-171A**

Blast Cleaning

Exhibiting in booth No. 749, the Pangborn Corporation will show latest developments in air and airless blast cleaning equipment. Typical cost cutting applications will be explained by the exhibitors sales and engineering personnel. **T-4-171B**

Carpenter Tool Steels

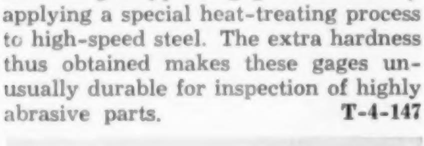
Horace T. Potts Company, booth No. 1165, will exhibit the complete line of tool steels manufactured by Carpenter Steel Company. **T-4-171C**

Fixture Accessories

Vlier Manufacturing Company will have on display a complete line of jig and fixture accessories and components, including torque thumb screws, spring plungers, stops and fixture keys. Booth No. 427. **T-4-171D**

V-Nide Gages

Republic Gage Company, booth No. 947, will exhibit its line of V-Nide Gages, this being a type of gage hardened by applying a special heat-treating process to high-speed steel. The extra hardness thus obtained makes these gages unusually durable for inspection of highly abrasive parts. **T-4-147**

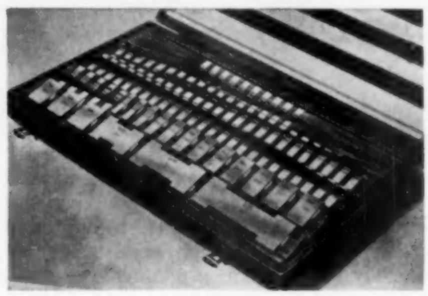


Microcasting

Microcasting for industry will be the theme of the exhibit by Austenal Laboratories, Inc., booth No. 520. These castings will be displayed in high temperature alloys, low alloys and alloy and tool steel. **T-4-147A**

Carblox Gage Blocks

Webber's Carblox Thermo-Guard Blocks, by Webber Gage Company, feature two advantages to tool makers. First, the high wear resistance insures years of precision and largely eliminates the need of a periodic check-up to detect undue wear. Second, they are insulated from body heat.



The heat transmitted from the hands can cause an ordinary 4 in. carbide block to grow approximately 0.000025 in. in 15 seconds. To overcome this fault, Webber "Thermo-Guards" are in laid in all 2, 3, and 4 in. carbide blocks—completely insulating them from the heat of the hand. No need to "cool off" after handling. Booth No. 708.
T-4-116

Mill & Factory

Among "Tools of Today" for manufacturing executives is Mill & Factory, a Conover-Mast publication. In addition to this magazine, C-M will have the magazine Purchasing and Purchasing Directory. Booth No. 308.
T-4-116B

Rockwell Hardness Tester

Exhibited by the Wilson Mechanical Instrument Co. will be a Rockwell hardness tester—illustrated—and the Tukon Microhardness tester, the latter used for research and control of hardness at the very surface of materials. The L. R. Model will be on exhibit. Space No. 226.
T-4-30

Lead Screw Tapping

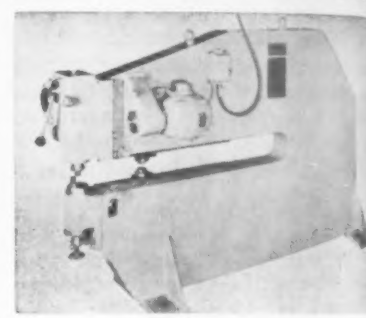
Kaufman Manufacturing Company, booth No. 1120, will demonstrate a lead screw tapping machine with 2-spindle multi-heads; also, indexing fixtures and machine components. **T-4-30A**

Die Casting Demonstrated

An air-operated high-speed, small die casting machine—Model M55A-HF—will be exhibited in operation on zinc die castings by DCMT Sales Corporation, booth No. 412. **T-4-30B**

Plate Cutting Equipment

In booth No. 958, the American Pullmax Co., Inc., will exhibit the Pullmax sheet steel and plate cutting machines. These machines range in capacity from 14 ga. to 11/32 in. in mild steel. Demonstrated will be a novel method developed for cutting straight, circular, and irregular designs, nibbling, template and slot cutting, plus heading and folding in metal of all types. **T-4-14**



Turret Millers

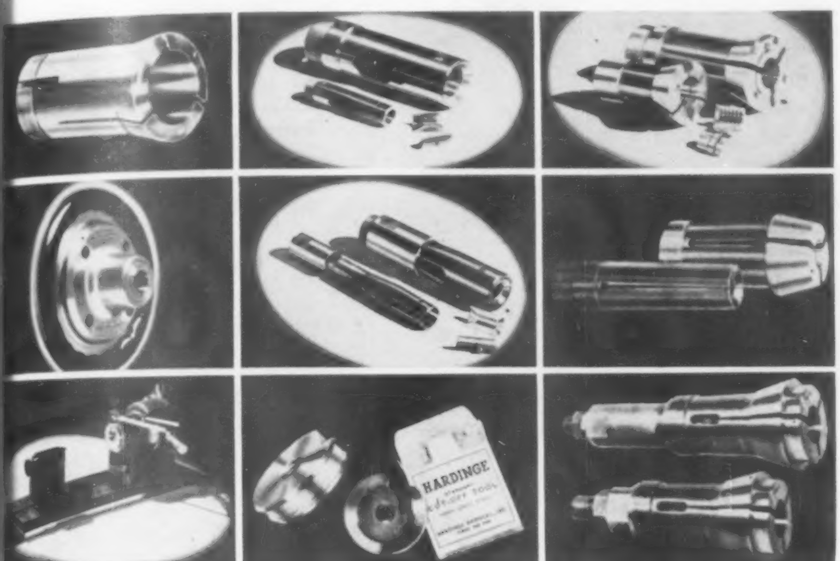
Bridgeport Machines, Inc., will exhibit turret-type millers, milling machine attachments and accessories. Booth No. 1031. **T-4-14A**

Midget Punch Press

Benchmaster Mfg. Co. will feature their "Midget" press, a 1-ton unit standing only 17½ in. high. Also exhibited will be larger presses, an automatic roll feed, milling machines, rotary tables, a lathe attachment and machine accessories. Booth No. 1150. **T-4-14B**

TOOLS OF TODAY

Hardinge Brothers, Inc., to Demonstrate Precision Tools

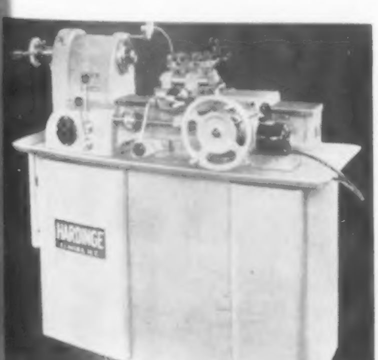


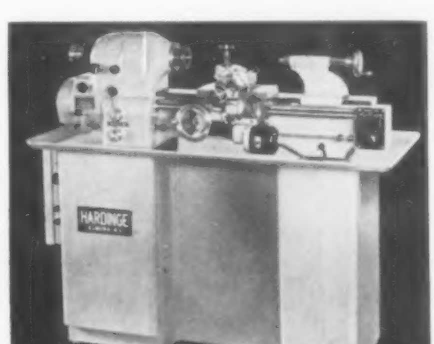
Hardinge Brothers, Inc., will have two booths for their extensive exhibit of precision tools. In space No. 835 will be exhibited the company's latest developments in both tool room and production precision machine tools.

In the tool room section of space 835 will be shown three machines matched for precision work: The Model HL 10 in. Swing Tool Room Lathe, illustrated, the Model DV59 Precision Lathe, and Model UM Universal Milling Machine. These matched machines are engineered for the ultimate in precision work.

The production machine section, space 835, will contain Models HCT and HC Chucking Machines—the latter illustrated—Model AC 59 second operation machine, Model DSM59 high speed precision second operation machine, which will feature production threading, and Model HQ59 hand screw machine, which will be used to demonstrate high speed precision bar work. All equipment in this space will be in operation during the run of the Exposition.

In space No. 701, which will contain tool room and production tools and accessories, Hardinge will display their complete line of precision Sure-Grip master type as well as conventional collets and pads; Style "B" master feed fingers and pads; circular form and cut-off tools; collet Index Fixtures and nose-type Hardinge-Sjogren speed collet chucks, all as illustrated. **T-4-60 A-B-C**





Golden Anniversary

Among a broad line of precision gages, the B. C. Ames Company will show a Dial Micrometer with range 0-4 in. Of particular interest, the company plans to celebrate 50 years of precision craftsmanship and quality in micrometer dial indicators and gages, in connection with which will be issued their Golden Anniversary Catalog. Their exhibit—space No. 710—will highlight the Ames Anniversary. **T-4-60-D**

Cylinders by Miller Motor

In space No. 735, Miller Motor Company will exhibit a complete standard line of Hydraulic Cylinders that, according to the manufacturer, meets all the specifications and recommendations of the JIC Standards that specifically relate to sealing devices, cylinders and pistons.

Produced in bores 1½ to 12 in. for pressures 2000 to 3500 psi operation, these cylinders have solid steel heads, caps and mountings, and cylinders are bored to a 15 micro-inch polished finished within 0.0005 in. tolerance. In all other respects, these cylinders are "engineered" for maximum performance with long service life. **T-4-58**

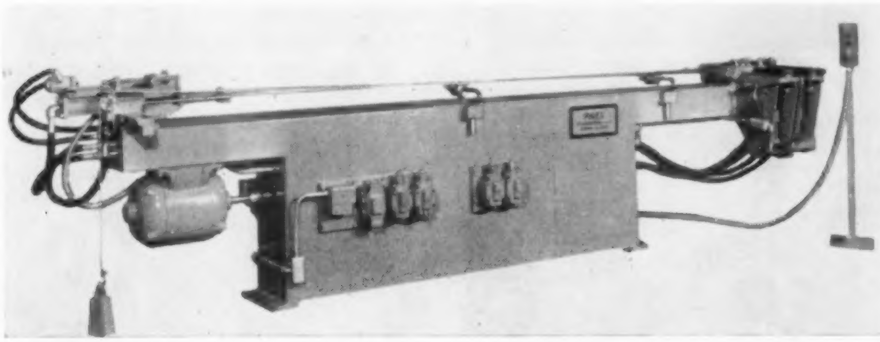
Grinders and Optics

Nife Incorporated will exhibit two Swedish-built precision grinders—the UTG-14, illustrated, and the UTG-8, the latter similar to the grinder by the same maker which was introduced in January **The Tool Engineer**. These machines, built by Svenska Ackumulator A/B Jungner, are versatile machine tools adaptable to a wide range of precision grinding operations.

Also, Nife is expected to show a line of precision optical instruments—and, as a last minute hint—a "surprise package" that should be of more than ordinary interest to Tool engineers and especially to automobile owners. Booth No. 12. **T-4-203**

Pipe Bending Machine

Pines Engineering Co., Inc. will show full-automatic hydraulic Tube and Pipe Bending Machines in space No. 1168. The machine shown—size ¾ in. with push button controls, gasket mounted valve panel and pilot-operated hydraulic circuit, will be in actual demonstration during the run of the ASTE Exposition. **T-4-59**



Dimensional Control Gages

In an extensive exhibit, booths Nos. 305-309, Federal Products Corporation will display representative models of over 20,000 gages manufactured by this company, which is devoted exclusively to designing and manufacturing all types of dimensional indicating gages.

Gages typical of all types of gages made by Federal will be shown. These include dial indicators and attachments; dial indicator or mechanical type gages; dimensional air gages of extremely low maintenance and accuracy; electronic, and automatic size sorting gages.

Also, continuous measuring gages for flat or round material; automatic machine dimensional control gages; and Electricator-Dial Indicator and signal light-electrical gages. **T-4-93**

Hot Work Steel

B-47 Hot Work Steel will be the center of attraction at the exhibit of Allegheny Ludlum Steel Corporation, booth No. 618. This steel, said by the maker to be the "latest in hot work die steels," has but recently been offered to die trade. Sample dies made from the B-47 steel will be on display.

The company's booth will be divided between tool steels and Carmet—sintered carbide—alloys. The remainder of the tool steel section will comprise a complete range of tool steels, including high speed, cold work, hot work, shock resisting, and carbon tool steels in bars, forgings, flat rolled strip, coils drill rod and tool bits. **T-4-93A**

Broaching Know-How

In line with the cost-cutting theme of the ASTE Show, Detroit Broach Company will demonstrate actual savings to be effected with the wide variety of broaches and broaching tools to be exhibited. In addition to sales personnel, Detroit Broach engineers will be in attendance to give desired technical information.

Among broaches will be an exhibit, with complete information, of "Big Boy", said to be the world's largest broach—84¾ in. long x 9 3/16 in. in diameter. Weighing over a half ton and removing 2¼ lbs of steel per pass, this metal-working giant is used to produce the 44 tooth involute spline in bevel drive gears for Eaton 2-speed truck axles at what is said to be a phenomenal savings.

In addition to exhibits and dissemination of broaching know-how, the company will show an interesting film which vividly portrays the complete story of production. Space No. 505. **T-4-59A**

Post Gages

Featured by Tubular Micrometer Company will be the Tumico post gages, with which boring bar cutters may be set for semi-finish finish cuts by a single check measurement.

The base is clamped on the boring bar just behind the cutting tool, spaced so that the micrometer spindle will contact the cutting edge of the tool. The tool is then set exactly from reference to the bar diameter; and exactly to finish on the next cut by use of the standard Tumico micrometer head. Space No. 722. **T-4-34**

The Tool Engineer

As the official publication of the American Society of Tool Engineers *The Tool Engineer* is the authority on the latest developments in the field of "making things," whether small-lot or mass production. Its editorial pages tell the "how, what and why" of manufacturing techniques and the tools used and these tools are presented monthly in the "Tools of Today" section.

The gadget pages convey ideas for short cuts on doing the usual jobs, as well as for those "knotty problems." The ASTE news, a feature of the magazine, keeps members posted on Society activities and also serves as a review of technical sessions in the many ASTE chapters. The Andygrams add a touch of human interest, while North, East, West, South in industry gives NEWS of "who is doing what, and where." To read the Tool Engineer is to be abreast of the times in mass manufacture. The ASTE booth, No. 888.

Carbide Wear Parts

Adamas Carbide Corporation will exhibit tungsten carbide tool tips, dies and wear parts. Booth No. 406. **T-4-34A**

Nilco Spline Gages

Among other gages by Nilsson Gage Co., Inc., space No. 1151, will be their recently designed Nilco external and internal spline gages. The first, designed around the standard Nilco dial snap gage, uses hardened rolls on the upper and lower anvils and a lifting lever which depresses the lower anvil to clear the OD of the spline or gear.

This gage will check pitch diameter of gears having odd or even numbers of teeth. The lower anvil is free to rotate slightly so that the two rolls can align with the gear teeth.

The internal spline gage may be simply made up from the standard Nilco dial bore gage by removing the centralizing unit, which is not an integral part of the gage. However, centralizing is not necessary since this is effected by the teeth of the spline. **T-4-[illegible]**

Machinery's Handbook

n indispensable "tool" for machine igners, mechanical engineers, tool ineers and designers, shop execu-s, skilled mechanics, engineering dents and apprentices, Machinery's ndbook in the 14th Edition contains ortant additions and revisions which ance its current usefulness. Of espe- importance are new data for the fied and American Standard Screw ead System, including data for the classes of screw thread limits which essential to the practical application this Standard.

Sections on broach design, electric otors, worm gear design, and roller ain standards, have been extensively vised in the Fourteenth Edition. ese, together with numerous other ditions and improvements, make a rsonal examination of this standard ference work the best way to judge value in the light of present-day re-irements of the metal-working in-stries. Space No. 101. **T-4-92**

"Tool" by Frederick Post

In line with the inclusive nomencla-re of tool engineers, to whom a tool anything used in design or manufac-re, the Frederick Post Company, oth No. 326, has applied that term to latest catalog.

It embodies what is said to be a vastly proved method of selecting and iden-ying the many kinds of special print-g and reproduction papers, as well as e vellums and tracing papers used for e original drawings. Copies will be ailable to visitors at the Post booth.

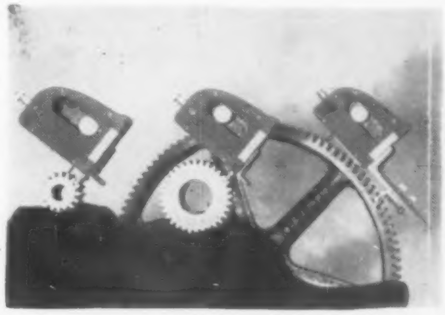
T-4-92A

Hydraulic Punches

Mueller Engineering Company will ve in operation a 100-ton Hydraulic ess, operating at 10,000 psi. working essure. Featured among the tools to exhibited will be hydraulic strippers d a self-sealing hydraulic high pres-re connector. Mueller will also show complete line of punches and retain-s. Space No. 639. **T-4-92B**

Gear Checker

Urbauer Engineering Company will exhibit the Gearmaster instrument. This tool, together with charts for all spur gears, makes it easy for any mechanic to find all measurements and characteristics in a gear in one setup, and in a single operation.



Chordal measurements, tooth thickness, tooth spacing, tooth form, tooth pressure angle, backlash allowance, pitch diameter, diametral pitch, and possible mandrel run-out are quickly found in spur, helical, herringbone, and internal gears as well as in sprockets for silent and roller chains. Booth No. 14.

T-4-194

Liquid Honing Machine

Vapor Blast Mfg. Co., booth No. 555, will feature their type B20 vapor blast liquid honing machine. This unit, said to be the company's latest, is offered with optional accessories such as track, handling car, and power rinse station. Booth No. 555. **T-4-194A**

Nichols Twin Mill

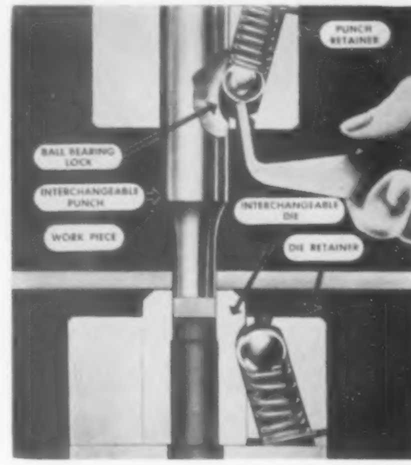
Featured by Nichols Morris-Corporation, booth No. 931, will be a line of milling machines manufactured by W. H. Nichols Company. The exhibit will include the Nichols Twin Mill, illustrated, and Nichols "rise-and-fall" Hand Millers as well as tool room milling machines and semi-automatics.

Along with these machines will be displayed various attachments and appliances that greatly enhance the scope of these precision machine tools.

T-4-99

Interchangeable Punches

R-B Interchangeable Punches and Dies will be featured by Allied Products Corporation, booth No. 665. Demonstrations will be made of the interchangeable feature which permits fast installation and easy removal when punch or die replacement is desired. The reasons why these products save time and money in die building will also be presented.



In addition, Allied will exhibit samples of cold forged parts and hardened and precision ground parts manufactured by the company. **T-4-103**

Power Hack Sawing

E. C. Atkins & Co., booth No. 654, will have an action display of power hack sawing under production conditions. Also, other saws such as circular and metal-bored plastic saws and Dura-tip saws for wood and plastics.

There will also be a demonstration of power hack saw sharpening. **T-4-103A**

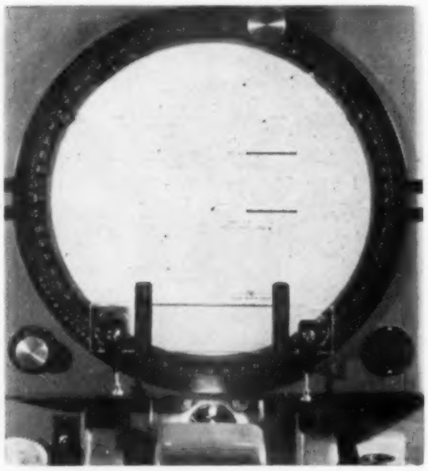
Universal Etcher

Ideal Industries, Inc., will exhibit their Universal Model Etcher, designed for etching small tools as well as large parts. Anything made of steel, iron or their alloys can be quickly etched with any of four etching heats—120, 240, 420 or 700 watts—quickly selected by a rotary tap switch.

Cables, writing tools and ground clamp are completely enclosed in a portable carrying case, the cover of which forms a work plate for etching small parts and tools. Booth No. 1048. **T-4-61**

Contour Projectors

Optical comparators and contour projectors, staging fixtures, chart-gage screens for cost saving in tool room, gage laboratory, production, or quality control inspection applications will be demonstrated by Engineers Specialties Division, in booth No. 129.



11 dimensions, within 10 seconds, are checked to within "go" and "no-go" tolerance limits, including actual measurement in 0.001 in. for diameter tolerance deviation. While only the "screen" of the Contour Projector previously mentioned is illustrated, the ESD exhibit as a whole includes a wide variety of ultra-precision instruments for dimensional quality control. **T-4-70**

Thread Tools and Comparators

The extensive exhibit of the Jones & Lamson Machine Company, space No. 831, will include a complete line of J & L optical comparators. Among these will be numerous accessories and fixtures, as well as a comprehensive selection of precision-made charts. The latter include radii, grid, protractor, thread, and special charts covering a wide range of inspection needs.

Also shown by Jones & Lamson will be carbide cutting tools and automatic-opening Thread Dies. The die head display will include both radial chaser and tangent chaser types, and a recently designed Chaser Grinder. **T-4-70A**

"Live Spiral" Drill

Featured in the exhibit of Carboloy Company, Inc., will be the Corboloy "Live-Spiral" Masonry Drill, said to be the most revolutionary development in the history of masonry drilling. A unique method of raising dust out of holes, while drilling, permits holes to be drilled continuously, faster, deeper and with less effort. Space No. 736.

T-4-95

Falcon T-I-Drive

The T-I-Drive, by Falcon Tool Co.—booth No. 560—is designed to hold carbide-tipped tools when machining. This T-I-Drive — short for Taper Interchangeable—has a sturdy taper in conjunction with a position 2-point drive. This combination insures a concentric and rigid tool, a necessity in the case of carbide tools, both as to speeds and feeds.

The T-I-Drive can be adapted to any shank-type cutting tool, but is especially efficacious with carbide tools since the concentricity and rigidity holds tool breakage to a minimum. **T-4-91**

Milling Attachment

The Milmaster, by Bemis & Call Company, converts a horizontal or vertical milling machine into a universal miller and thereby extends the working capacity of the machine on which it may be mounted.

Adjustable to almost any position, the attachment handles precision angular milling, drilling and boring. It accommodates cutters up to 4 in. in diameter and a standard chuck of ½ in. capacity for drilling and reaming up to 90 deg. angle to drive shaft. Booth No. 1054.

T-4-91A

Granite Inspection Tools

A complete line of basic precision inspection equipment in black granite—diabase—will be exhibited by Rahn Granite Surface Plate Co., space No. 720. This line includes surface plates, angle plates, parallels and straight edges, with claimed tolerances to 0.00005 in. held on all of these items. This accuracy is obtained through specially developed hand lapping procedures, with the original accuracy in manufacture said to be maintained almost indefinitely.

The granite will not rust, nor can abrasives become embedded in the hard surface. Even should it be accidently nicked, no burr will be raised. It is claimed that, in normal usage, the accuracy will be retained for from 10 to 20 years. Should they become worn after that, the manufacturer will recondition them at a cost no higher than the cost of rescraping metal equipment.

T-4-84

Precision Jig Borer

The Model No. 2 Moore Jig Borer which provides rapid table setting within 0.0001 in. by coordinate locating and jig bores holes up to 5 in. in mild steel or cast-iron, will be on exhibit by the Moore Special Tool Co., Inc. Infinitely variable spindle speeds, push button controlled, range from 90 to 3000 rpm.

Three power feed ratios—0.0015, 0.003 and 0.006 in. per revolution of spindle in either direction—extend the versatility of this machine. Other features include a totally enclosed drive mechanism, disconnect clutch for easy indicating, centralized control panel and trip mechanism to prevent jamming of lead screw nuts through over-travel. Space No. 1007. **T-4-3**

Hack Saw Machines

Armstrong Blum Manufacturing Company will exhibit, for the first time, models of the Series 6 and 9 Marvel high speed heavy-duty ball bearing hack saw machines. The many refinements of these machines are in accord with both J.I.C. and Machine Tool Builders electrical standards.

Also initially shown will be fully automatic models, of the Series 6A and 9A machines, equipped with auxiliary foot lever control of power bar-feed. These models are fully universal for both automatic and semi-automatic work.

Also, Series 4B models, and the No. 8 Marvel metal band sawing machine, the Series 18 hydraulic hack saw of 18x18 in. capacity. In actual operation will be a high-speed-edge hole saw, while Marvel hack saw blades will be seen in actual high speed performance tests. Booth No. 521. **T-4-20A**

Welders' Seating Reamers

The Gammons-Hoaglund Co., space No. 31, will have on exhibit a wide display of reamers, including the Welders' Seating Reamer, the Gammons Duplex (stocked in four sizes—and Gammons Helical, stocked in three tapers. Also, diemakers reamer. **T-4-129**

A Rounded Display

Griffith-Raguse & Co., Inc., are authorized distributors, for Carborundum Co., Black & Decker, Osborn Mfg. Co., Louis Smit Co., Graham Rotary File Co., National Products Mfg. Co., Calder Mfg. Co., Mummert & Dixon Co., Porter-Cable Co., the Capewell Mfg. Co. and Detroit Surface Machine Company.

Their exhibit, space No. 1112, will include a broad line of grinding, polishing and buffing equipment, wheels and accessories, metal cutting, hand and hack saws and electric power tools and accessories. **T-4-129A**

Desegatized Brand Steels

"The Tools of Today" require the "Tool Steels of Today" and Latrobe electric steels—have been developed to meet modern demands and to supply tool and die makers with the highest quality tool steels that can be produced —as for example, the exclusive Latrobe Desegatized Brand steels.

As shown by the photograph of a polished and etched disc cut from a bar of 4 in. round, Latrobe Desegatized Brand high speed steel has uniformity of structure and absence of carbide clusters. This assumes a top-quality tool steel which is uniform in response to heat treatment, achieves maximum hardness, has greater wear resistance, toughness and durability in service. Booth No. 808.
T-4-56

"Sure Feed" by Producto

The Producto Machine Company has recently placed in production a simple, accurate and economical Stock Feed, which will be a feature of the company's exhibit, booth No. 1065.

Called the Producto Sure Feed, its simplicity is the key to its true appeal. No springs, cams or fancy machanisms are used for feeding. Only two drive plates operate the feeding link, and feed can be adapted to any ordinary press without press alteration.

To set up proper feed interval, all that is required is a piece of round stock faced off to desired stamping length. Using this as a gauge, the feed is set, then locked and ready to run.

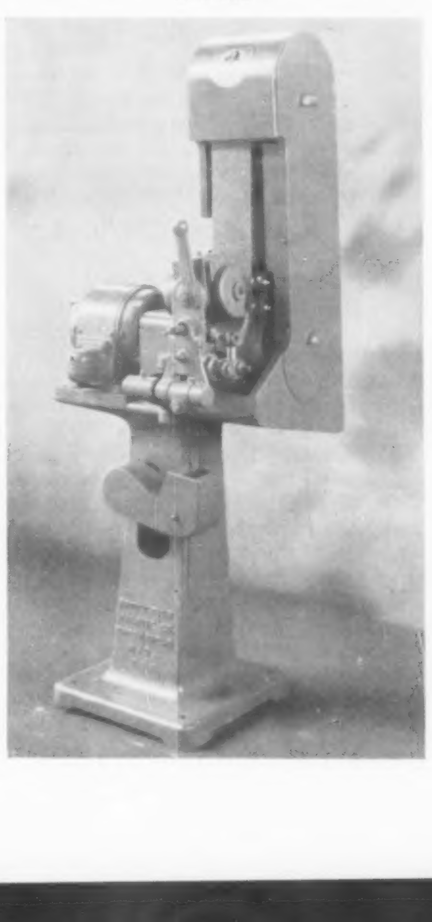
Also exhibited will be a variety of cost cutting dies and tool makers equipment, all of which complement the company's main line, which is die sets. Among these tools may be mentioned a 50-ton shearing and try-out press, precision machine vises, a universal hand tapper and a die-set separating machine. **T-4-56A**

Production Publication

The Bramson Publishing Company, booth No. 657, will exhibit Production Engineering and Management Magazine—"America's Metalworking Mass Production Authority." **T-4-56B**

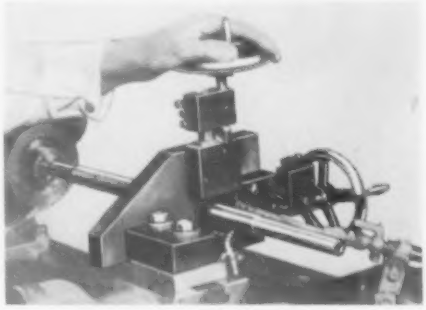
Centerless Polishing

Production Machine Company will demonstrate the centerless method of polishing and buffing cylindrical parts. The Type S Machine, to be displayed in booth No. 1042, handles cylindrical work up to 1½ in diameter, tapered or straight. A variety of finishes can be obtained with abrasive belts for cutting, and felt belts for polishing and buffing.
T-4-146



Todd to Show Turnomat

A demonstration of the Karge Turnomat will be featured by the Contract Division of The Todd Company, Inc., space No. 310. The Turnomat is a precision attachment for lathes to turn or taper long and intricate parts which are difficult to produce by ordinary procedures. In addition to the working demonstration of the Turnomat, there will be a display of the intricate, long, slender parts which can be produced by the device.



The Turnomat is available in six different models and will fit any size or make of lathe. It mounts directly on the top of the cross slide or compound rest, transforming the ordinary lathe in a matter of minutes into precision turning equipment for working metal, plastics, fiber, or rubber, producing unlimited repetitive diameters and extraordinary slenderness and concentricity.
T-4-49

Steel Magazine

Steel is the magazine of metalworking and metalproducing, covering the latest developments in tool designing and tool making in addition to news and market information.

The professional journal of chief engineers and designers, it is the authoritative coverage of all phases and developments in the casting industry. Monthly digest of new tools and equipment for use in the manufacturing industries. Space No. 942. **T-4-49A**

Variable Speed Drive

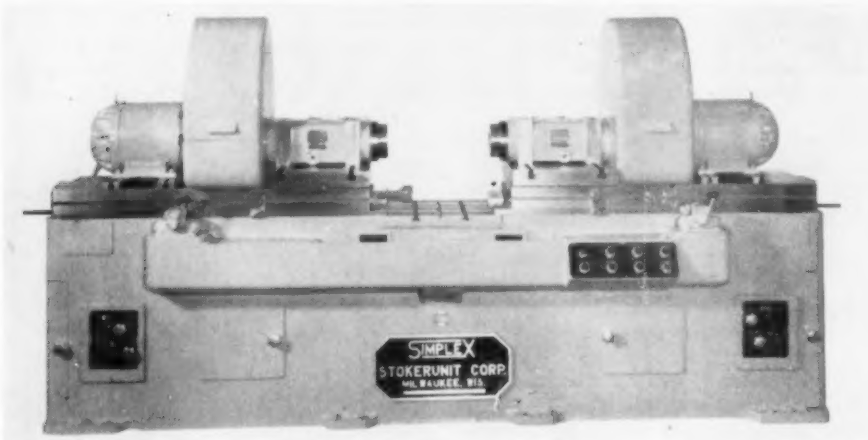
Illustrated is a job of cutting tapered teeth on convex surface to extremely close tolerances. Here, a Link-Belt P.I.V. Variable Speed Drive positively controls oscillation which, in turn, determines and holds shape of tooth taper and width to close limits. This drive, by the Link-Belt Company, is but one of the many cost cutting devices to be exhibited at the ASTE Show. Space No. 721. **T-4-141**

Precision Boring Machine

Simplex Machine Tool Division, the Stokerunit Corporation, will exhibit the Simplex 2U-two-way hydraulic feed precision Boring Machine.

This machine features fixtures and work mounted stationary on the bed and having the precision boring heads, with cutting tools, advance into the work. This method of precision boring does not limit the size of the job since both work and fixture are stationary and rigidly mounted. Space No. 1066.

T-4-149



The Brown & Sharpe Exhibit

In an extensive display, space No. 848, the Brown & Sharpe Mfg. Co. will exhibit Johansson Gage Blocks among other B & S tools. These precision aids to quality control have three fundamental uses:—as master laboratory standards for control of measurements; as actual working instruments; and for periodic checking of inspection gages at the bench. As now manufactured by Brown & Sharpe, these gage blocks can be finished chrome-plated for extremely severe service.

Also displayed will be electronic measuring equipment, with which readings can be made in sensitivities from 0.0001 in. to 0.00001 in. for each graduation in scales reading to 10 on each side of zero, electronic sorting and gaging equipment which is custom engineered for automatic inspection and sorting. These latter additions to Brown & Sharpe line were recently introduced in the Tool Engineer, Tools of Today section.

Also displayed will be a line of pumps including Models 8021, 8061 and 8101 automatic reversing vane pumps; these, together with precision tools and instruments, combine to make a highly interesting exhibit of cost cutting tools.

T-4-87

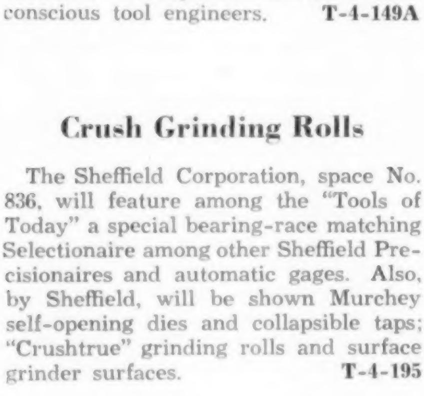
Plan for Cost Reduction

The D. A. Stuart Oil Company, will show—booth No. 116—a blueprint for cost reduction known as Stuart's Wise Economy Plan. This is a "three-point" plan for the thorough evaluation of metal working and special lubricant practice in manufacturing plants said to result in a recommended course of cost-reducing procedure.

Since it is generally considered that production and productive efficiency can be greatly increased through the proper selection and application of metalworking oils—say up to 30 percent through intelligent use of cutting oils and coolants—the Stuart exhibit should be of especial interest to cost conscious tool engineers. T-4-149A

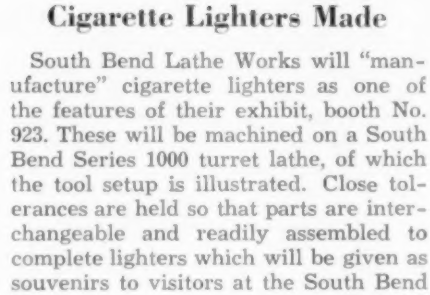
Crush Grinding Rolls

The Sheffield Corporation, space No. 836, will feature among the "Tools of Today" a special bearing-race matching Selectionaire among other Sheffield Precisionaires and automatic gages. Also, by Sheffield, will be shown Murchey self-opening dies and collapsible taps; "Crushtrue" grinding rolls and surface grinder surfaces. T-4-195



Cigarette Lighters Made

South Bend Lathe Works will "manufacture" cigarette lighters as one of the features of their exhibit, booth No. 923. These will be machined on a South Bend Series 1000 turret lathe, of which the tool setup is illustrated. Close tolerances are held so that parts are interchangeable and readily assembled to complete lighters which will be given as souvenirs to visitors at the South Bend booth. T-4-169



Sip Jig Borer

Rudel Machinery Company, booth No. 502 will introduce a new boring and milling machine built by Societe Genevoise D'Instruments de Physique. This machine, a development of the Sip jig boring machine, adopts a hydraulically actuated movement of the table and a larger head and heavier quill to perform milling operations.

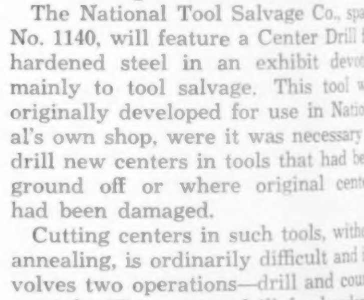
Also exhibited will be a rotary table for use with the Hydroptic machine. This table introduces optical settings designed to insure a permanence and accuracy of the same order as the machine itself. Readings to one second of arc are obtained with this accessory. In addition, several Societe Genevoise instruments will be exhibited.

This equipment presents many novel design features and should be of considerable interest to visitors. Booth No. 502. T-4-169A

Unique Center Drill

The National Tool Salvage Co., space No. 1140, will feature a Center Drill for hardened steel in an exhibit devoted mainly to tool salvage. This tool was originally developed for use in National's own shop, were it was necessary to drill new centers in tools that had been ground off or where original centers had been damaged.

Cutting centers in such tools, without annealing, is ordinarily difficult and involves two operations—drill and counter-sink. This center drill for hardened stock, said to have been proven practical in thousands of actual cuts, is now offered to the trade. T-4-80



Interchangeable Cutters

The Apex Tool & Cutter Co., Inc., will introduce a Tungsten Carbide Tool with interchangeable serrated cutting bits which are adjustable for turning, boring and facing operations, as well as for wear.

These tools are made in sets with holder and assortment of tool bits, of standard shapes, for machining various metals and materials, both ferrous and non-ferrous. Space No. 5. **T-4-104**

Disintegrating Equipment

Clinton Machine Company will exhibit equipment for removing broken hard tools such as drills, taps or dowel pins. This equipment will also pierce shaped holes into hardened metals, including dies and other tool components where it is desirable to make alterations without annealing. These machines, of which a typical component was illustrated in January issue, The Tool Engineer, will be demonstrated in space No. 1057. **T-4-104A**

Stud Welding Equipment

The Graham Stud Welder, to be shown in booth No. 672 by the Graham Mfg. Co., is a capacitor-operated, self-timed device using tipped studs which, on coming in contact with the work, start an arc that causes ionization. This allows a path for the main discharge current of the capacitor to form an arc sufficient to melt both the full stud end and the workpiece directly under it. A simultaneous blow of the pneumatic gun causes the pieces to weld securely.

Available in single and multiple-gun machines for general application; also, machines with hopper stud supply, automatic feed, and rotary index table for handling up to 4,000 pieces per hour. The welding cycle is said to be completed in 1/1000 second. **T-4-172**

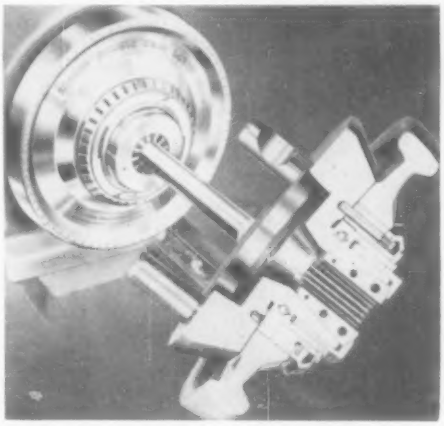
Automotive Industries

Automotive Industries magazine, space No. 408, is the working tool of production executives in the automotive industries. Issued twice each month, it provides full coverage of the latest developments on production methods and equipment in the automotive and aircraft manufacturing plants.

First published in 1895, it has paralleled the growth of the huge automotive field and today is the accepted authority on engineering, production, design and administration relating to the manufacture of cars, trucks, buses, engines, aircraft, parts, and road and farm machinery. **T-4-172A**

Rubber-Flex Collets

Featured by Jacobs Mfg. Co. will be the Jacobs Spindle-Nose Lathe Collet, which employs the revolutionary Rubber-Flex lathe collets. The outstanding feature of these collets is that each has an effective gripping range of a full ⅛ in., with accuracy and gripping power constant in this range.



Only 8 collets are needed to chuck all bar sizes between 1/16 and 1 in. Their unique design offer gripping power said to be severalfold over that of conventional split steel collets, while the chuck—made up of hardened and ground steel parts throughout—is said to offer economies never before achieved in lathe collet equipment.

The economies to be achieved in original investment, maintenance and upkeep by these cost-cutting tools will be demonstrated by actual operation at Jacobs booth No. 671. **T-4-7**

Oils by Cities Service

Cities Service Oil Company will present their latest developments and refinements in neutral oils and bright stocks produced in their recently completed $42 million refinery at Lake Charles, La.

These products are the choice cuts of selected paraffinic crudes, from which the maker states that the finest finished lubricants are produced. The Cities Service will feature a combustion analyzer, demonstrating its application to all fuel consuming equipment. Booth No. 636. **T-4-7A**

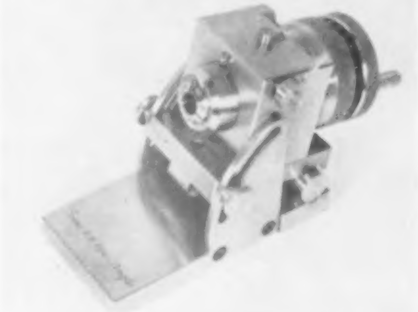
Hydraulic Marking Machine

Among equipment to be displayed in operation by the Cadillac Stamp Company, will be Cadillac "45" hydraulic marking machine, said to give impressions from as "gentle as a kiss" to the crushing foce of 12,000 pounds pressure for flat, round and contour marking.

Also shown in full operation will be the Automark electric metal marking typewriter and the Automark marking machine. This equipment offers great production economies wherever marking of any kind is required, and full information on this advanced marking equipment can be obtained at booth No. 753. **T-4-131**

Master Grinding Attachment

Exhibited by the Star Gauge Company, space No. 40, will be Sta-Ga-Co master grinding attachment, a precision tool having the angle "formula" stamped right on the base plate.



Completely hardened and ground and said to be square within 0.0002 in., with spindle true within the same limits of tolerance, this tool can be set to vertical angles and rotary indexing to within 1 minute each, vernier settings—any positions—within 2 minutes. **T-4-73**

Heavy-duty Tapping Head

The Procunier "Tap-king" heavy duty tapping head, designed to simplify tapping of large size holes, to increase production and tap life, and to hold accurate thread depth and reduce operator fatigue, will be featured by the Procunier Safety Chuck Company.

Shown for the first time at the ASTE Industrial Cost Cutting Exposition, this tapper has a capacity of ⅜ to 1 in. taps in steel, 1⅛ in. in softer materials. Available with No. 3, 4, or 5 Morse taper shanks or with rigid accurate clamping housing to clamp around quill or drill press.

Other Procunier products operating or on display will include universal foot operated tapping machines, high speed precision tapping heads, quick-change chucks and collets, friction tap holders, "Tru-Grip" tap chucks and accessories. Booth No. 611. **T-4-189**

Grinding Wheel Dresser

Exhibited by Last Word Sales & Engineering Co., space No. 1161, will be the angle tangent-to-radius Wheel Dressers. The parallel and Jo-block method used provides a most accurate setting for difficult concave and convex wheel dressing jobs.

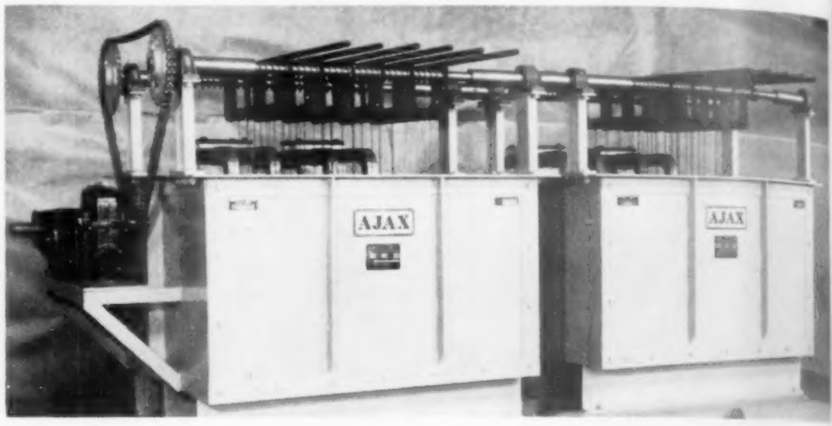
One dressing will give any two angles along with any set radius. For example, a wheel having a 10 deg angle surface tangent to a ½ in. radius-formed concave surface and a 20 deg angle surface —which is also tangent to a ½ in. radius—can be dressed with this accessory. **T-4-139**

Salt Bath Furnace

The Ajax Electric Co., Inc., will illustrate their Ajax Hultgren electric salt bath furnace installation, both batch and mechanized units, with color transparencies.

Sample products, from cotter pins to automobile bumpers, will be displayed and documented to show advantages of salt bath processing and its numerous applications.

The illustration shows preheating and hardening units equipped with overhead screw conveyors for moving work fixtures through baths on predetermined time cycle. Booth No. 434. **T-4-138**



Laundering Service

Institute of Industrial Launderers, Inc., will demonstrate the method of nationally serving the laundering and rental of coveralls, shop coats, and shop working towels. Booth No. 552.

T-4-139A

Knock-Out Grinders

K. O. Lee Company, manufacturer of "Knock-Out" universal tool and cutter grinders, will introduce the B800 and B860 Grinders featuring hydraulically-operated, automatically-controlled reciprocating tables, making this machine suitable for surface grinding. The recently developed Multi Speed-Head will be equally efficient for internal and external grinding. Other features are: heavier column, improved pedestal and improved tables and ways.

Also shown will be the K. O. Lee "Knock-Out" T500 Tool Post and Thread Grinder, designed to handle internal, external and thread grinding jobs with no additional equipment needed. The T500 can be mounted on most any machine tool which provides for a T-slot mounting, thereby adapting the machine for precision grinding. Space No. 566.

T-4-140

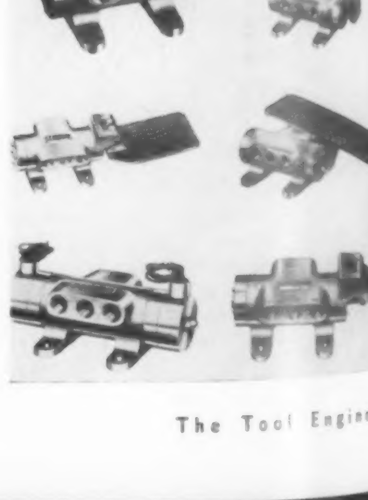
Centrifugal Castings

Janney Cylinder Company, Space No. 1036, will have an interesting display of finished machine products made exclusively from centrifugal castings. Truly among the "Tools of Today," centrifugal castings require no patterns and result in a more dense and homogeneous structure with improved physical properties.

Janney has been producing these finished products by centrifugal casting in brass, bronze, alloy irons, Monel Metal and Ni-Resist iron and Stainless Steel for upward of twenty years, and the products to be exhibited embrace all the knowhow acquired by two decades of experience. **T-4-130A**

Control Valves by Modernair

Among other products, the Modernair Corporation, booth No 957, will exhibit its CV Series Control Valves. These valves include a cam-operated model and a foot-controlled valve with spring return, as well as pilot valves and solenoid-operated units in various sizes and mountings. **T-4-43**



Lathes by Logan

Logan Engineering Company will feature the 955 Model Lathe at their booth, No. 1045. The 955 has 1 in. collet capacity, 1⅜ in. hole through spindle, 11⅛ in. swing, 24 in. between centers, and is mounted on a modern pedestal base with underneath drive.

The spindle is mounted on New Departure ball bearings with 12 spindle speeds from 45 to 1500 rpm. Quick change gear box gives 48 thread selection, right or left, from 4 to 224 threads per inch. A 957 Model, identical to 955 but with 36 in. between centers, will also be exhibited. **T-4-142**

Tool Engineers Handbook

Definitely to be classed as a working "Tool of Today" is the Tool Engineers Handbook, first edition published July, 1949. Written by tool engineers for tool engineers, it presents modern practice in design, planning and control, tooling and operations in all branches of mechanical manufacturing. In its 115 sections, totalling 2078 pages, are presented 923 tables and 2,833 individual charts, diagrams, and product drawings, chiefly drawn out of the know-how of the 18,000 tool engineer members of the American Society of Tool Engineers, the Handbook's sponsor. The ASTE booth, No. 888. **T-4-142A**

Electronic Comparator

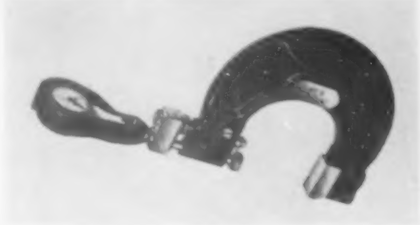
Among other precision inspection equipment, Graham-Mintel Instrument Company will feature a high sensitivity Electronic Inspection Comparator with a 2-scale amplifier.

Readings may be taken in thousandths or tenths, as plus or minus 0.0002 in., or plus or minus 0.00002 in., with repeat accuracy of 0.000001 in. The amplification factor is 75,000X. Space No. 1044. **T-4-86**

"Dializer" Conversion

Low cost and adaptability is claimed for a device to convert ordinary AGD snap gages to dial instruments. Called the Dializer, this device is inserted in place of two gaging pins of American Gage Design adjustable limit snap gages. Thus, a limit gage can be changed to a dial gage giving quantitative readings at a cost stated by the manufacturer to be far below that of a new dial snap gage.

At present the Dializer is available from the manufacturer, Standard Gage Co., Inc., for frames 1 through 6, checking range up to about 3 in. It will go in any model, A, B, or C, and in any make of frame if in accordance with AGD specifications. Dializers reading in either 0.0001 or 0.001 in. can be furnished. To be exhibited with other Standard Gage Co., tools in space No. 932. **T-4-109**



Indicate A-4-105-1

For further information, use Reader Service Card. See pages 129-130.

Unistage Compressor

Schramm Incorporated will have on exhibition several of their Industrial Compressors similar to the direct-connected or built-in motor type unit illustrated. Compressor and motor are assembled rigidly and in perfect alignment. There are no external flywheels or pulleys, no vibration and no bolts to adjust. Both compressor and motor are mounted as a single unit on a substantial steel base, which can serve as foundation. The outfit illustrated is also equipped with a cooling unit and—of particular interest—will furnish air to all Exhibitors using air operated equipment. Space No. 1132. T-4-47

Whiteprinting by Bruning

Five Bruning whiteprinting—BW—machines will be demonstrated, in operation, by the Charles Bruning Company, Inc., in booth No. 801. Visitors to the Bruning booth will see the following Bruning whiteprinters: Model 30 Volumatic, for large volume production; the Model 50, which is the most recent addition to the Bruning line of whiteprinters; Model 21 whiteprinter combination for moderate volume production; Model 11, for small production; and the recent Model 10, designed for general business or office use. The Model 10 should be of special interest to businessmen. All BW machines will be in actual production of Bruning whiteprint "direct positive prints" from tool engineering or mechanical drawings or anything written, printed, drawn or typed on translucet paper, cloth or film.

T-4-47A

Production Bender

Pedrick Tool & Machine Company will exhibit the Pedrick Model A-5 production bender, illustrated. The operator is required only to load, unload and start the machine, the machine completing the bend to predetermined curvature. It then resets automatically to starting position. Space No. 21. T-4-144

Midgets to Giants

The Ready Tool Company, space No. 204, will exhibit its Red-E-Tap-A-Hammer, an equally handy tool for the toolmaker, parts assembler, repair man or home craftsman. Designed to be gripped by the knurled shank, this hammer strikes a solid blow without rebound and without marring the work.

Also shown will be a line of Red-E live centers, of which the 600 lb. giant model shown, built for turning a 100 ton turbine motor shaft, is a typical example. These ball bearing live centers may be supplied in standard sizes or built to order. T-4-76

Cost-Cutting Inspection

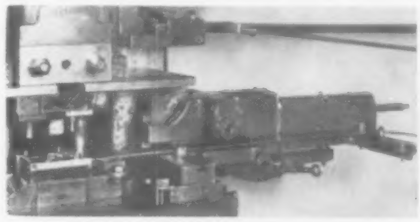
The Magnaflux-Magnaglo, designed for process control inspection on the production line, will be exhibited by the Magnaflux Corporation, booth No. 563. Featured will be the type KDN unit—illustrated—equipped with the Magnaglo.

This unit is portable and flexible, and 100 percent inspection of parts up to 54 in. long can be handled. The unit can be wheeled to any location for spot checking or control of a particular process causing cracking of material.

Zyglo, fluorescent penetrant inspection of non-magnetic casting and tools, will also be demonstrated, as will the Magnaflux Sonizon, the latter an excellent demonstration of ultrasonic inspection. T-4-143

Punch Press Feed

H. E. Dickerman Mfg. Company will feature the Rol-Di-Feed for punch presses, a radial feed providing increased range and versatility. This feed handles coiled or short strip up to $\frac{1}{16}$ in. thick and in any width where weight of stock does not exceed 2 lb. per linear foot.

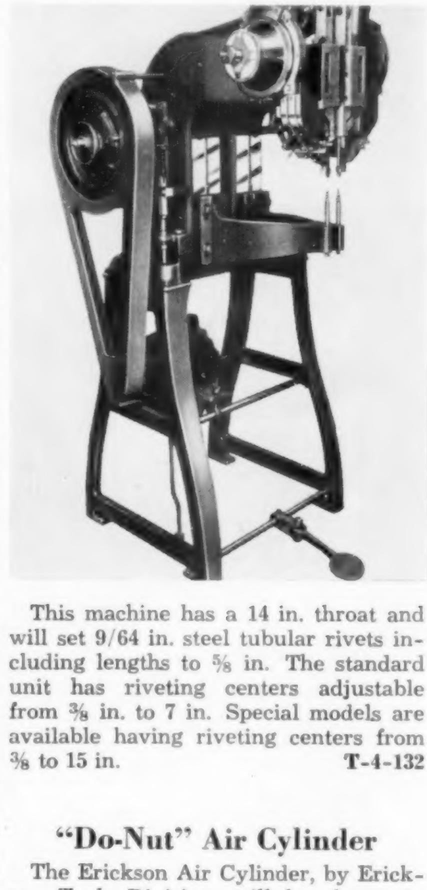


This cam-driven feed provides 9 in. of feed length on a 3 in. stroke press. Feeding throughout most of the 360 deg. of shaft rotation, the Rol-Di-Feed advances stock at a relatively low rate of speed, resulting in greater accuracy when feeding piercing and blanking, compound or progressive dies operating at high speed.

The unit is particularly suited to feeding deep drawing or forming dies where a large part of the press stroke is used for drawing or forming and only a small part of the total stroke remains available for feeding purposes. Booth No. 771. T-4-180

Double Rivet Setter

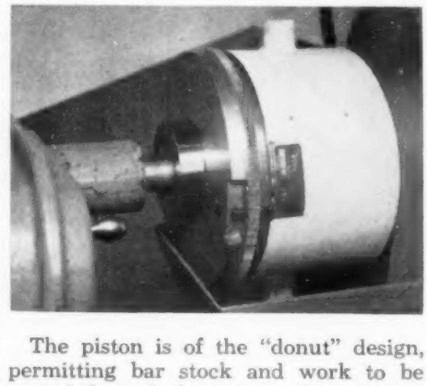
Among the machines to be exhibited by Chicago Rivet and Machine Company, space No. 1123, is their Model 214 double rivet setter. This recently designed machine will be in operation to demonstrate the value and use of having a machine with adjustable riveting centers.



This machine has a 14 in. throat and will set 9/64 in. steel tubular rivets including lengths to ⅝ in. The standard unit has riveting centers adjustable from ⅜ in. to 7 in. Special models are available having riveting centers from ⅜ to 15 in. **T-4-132**

"Do-Nut" Air Cylinder

The Erickson Air Cylinder, by Erickson Tools Division, will be shown in operation on a turret lathe set-up to operate an Erickson push-type Collet Chuck. This novel cylinder uses the mechanical advantage of levers — or dogs—to give several times the drawbar force of a conventional air cylinder with the same piston area.



The piston is of the "donut" design, permitting bar stock and work to be passed through the unit, as shown in the photo. Also shown will be the Erickson Speed Indexer in operation on a rise-and-fall milling machine with fully automatic set-up for indexing parts for regular machining operations. Space No. 240. **T-4-65**

Cutters by "Go and Go"

Goddard & Goddard Company will formally introduce and exhibit what is said to be an outstanding development in the line of carbide inserted blade milling cutters—namely, its lately developed "Serra Tip" line.

These cutters, of which a 10 in. face mill is illustrated, use solid carbide inserts, permit extremely fine tooth spacing and allow inserted blade construction in cutters as small as 1 in. in diameter. In addition to a "still life" display of a large and representative line of Go and Go cutters of all types, the Serra-Tip cutters will be thoroughly demonstrated to show their capacity for stock removal and smooth index action. Booth No. 1108. **T-4-71**

Oakite Cleaning Material

Oakite Products, Inc., will introduce an acid-type cleaning and surface-conditioning material, Oakite Compound No. 33, designed to remove dust, oxides, grease, oils and shop soils from metal surfaces, and to prepare ferrous surfaces and aluminum for sure-grip adhesion of paint, lacquer and enamel finishes. Booth No. 565. **T-4-79A**

Ring Punches and Dies

Fidelity Tool Supply will exhibit a standard line of precision made Ring Punches and Dies. Sturdily designed, accurately ground and made from hard, tough materials, with concentricity guaranteed by the maker, these sets require no complicated retainers. All that is necessary is a bored and counterbored hole.

The bushings, which have a tapered hole—said to be a novel development in the punch and die field—are especially designed to avoid "jamming" and to reduce down time. Space No. 1143.

T-4-66

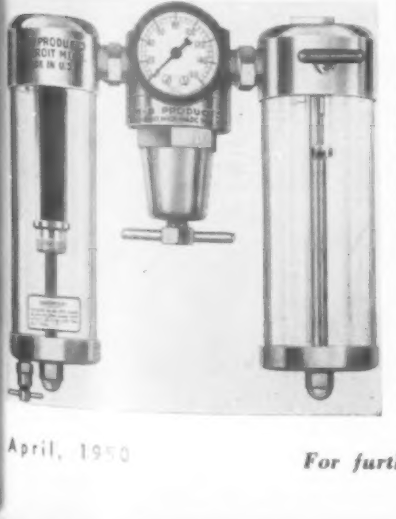
Press-Rite Machines

Sales Service Machine Tool Company will have an exhibit Model B heavy-duty Shape-Rite shaper, Keller power hack saws in capacities up to 6¾ x 6¾ in., and Press-Rite power presses in seven sizes ranging from 5 to 85 ton rated capacity. Booth No. 902.

T-4-201

Air-Line Filter

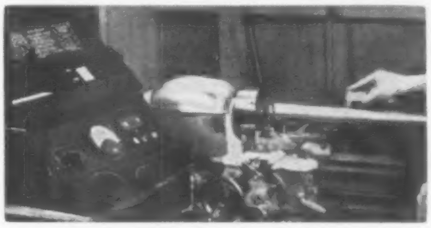
M-B Products will feature the "M-B" automatic air line filter, regulator and lubricator assembly among other M-B products to be exhibited in space 642. This "Sentinel of the Air Line" will be shown in operation. T-4-138



Profilometer Equipment

Physicists Research Company, space No. 233, will have in operation a complete line of standard Profilometer equipment for measuring surface roughness directly in microinches r.m.s The exhibit will embrace more than 10 manually and mechanically-operated Tracers for measuring on internal and external surfaces—straight, tapered, or circular—including narrow slots and grooves, extra-deep holes, and internal grooves and recesses.

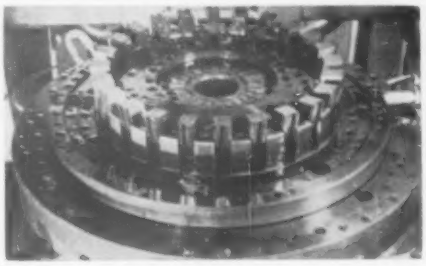
The exhibit will include the Mototrace, for use where mechanical tracing is desired; Type AB 3-speed Linear Pilotor, for straight-line mechanical operation of tracers built without skids, for measurements through very narrow openings and on similar inaccessible surfaces; Type RA Rotary Pilotor, for roughness measurements around internal and external surfaces of rotation and across circular grooves; and Type BQ Reading Recorder, for obtaining a permanent continuous chart record of the Profilometer meter reading where desired. T-4-83



Shear-Speed Gear Cutting

While Michigan Tool Company may not exhibit its latest developments in Shear-Speed Gear Cutting, visitors may obtain full information on this and other Michigan tool developments by visiting Booth No. 1017.

Shear-Speed machines for cutting internal gears, as well as internal splines and almost any irregular shape that lend itself to form cutting with radially fed tools, are now available from Michigan Tool Co., Minimum size—ID—which can be handled is 5.4 in., with maximum approximately 20 in.



In operation, the "internal gear" Shear-Speed machines simply reverse the tool-feed action used for cutting external gears. Thus, by using two inverted cones—see the "worms-eye view" —the tools are fed outward before each cutting stroke and slightly retracted on the idle stroke: Michigan tool engineers will be on hand to fully explain these machines. T-4-39

Spot Welder

An air-operated fully automatic repeat, timer controlled 5 KVA rocker-arm type spot welder will be exhibited by the Power Tool Division, Rockwell Manufacturing Company. This unit is equipped with a recently developed electronic weld timer that provides precision control from 3 to 80 weld cycles.

The off time control is pneumatic providing a wide range, easily adjusted. All sequence controls are housed within the welded steel cabinet type stand. The welder will handle from two pieces of 0.005 in steel shim stock up to two pieces of 14 gage steel sheet. Booth No. 843.

T-4-127

Die Specialties

The Metal Removal Company will present a complete line of die finishing specialties, also, will distribute catalog No. 20, showing the company's latest rotary tools. Booth No. 1160. T-4-127A

Oilite Machine Parts

Illustrated are a few of the many Oilite Bronze and Super Oilite—ferrous base—finished machine parts to be displayed by the Amplex Manufacturing Company, booth No. 1107. Such ready-for-assembly parts are produced to close tolerances at low cost. A variety of permanent filters, finished machine parts and oil-cushioned bearings made of Oilite Stainless Steel—a recent Amplex development—also will be displayed.

T-4-94

Optical Dividing Head

F. T. Griswold Mfg. Company will feature the OPL dividing head, booth No. 562. This head is designed expressly for application with precision machinery operations, and permits the operator of a milling machine, jig borer, or other machine tool to index with a speed and accuracy said to be impossible with mechanical dividing heads.

The optical system eliminates gears, sliding pins and perforated index plates and, since the optical control is not subject to wear, it will retain original accuracy for an indefinite period of time. The maximum error of indexing through 360 deg is said to held within 0.0005 in., measured at the periphery of a 12 in. circle. T-4-118

Micro-Drilling Units

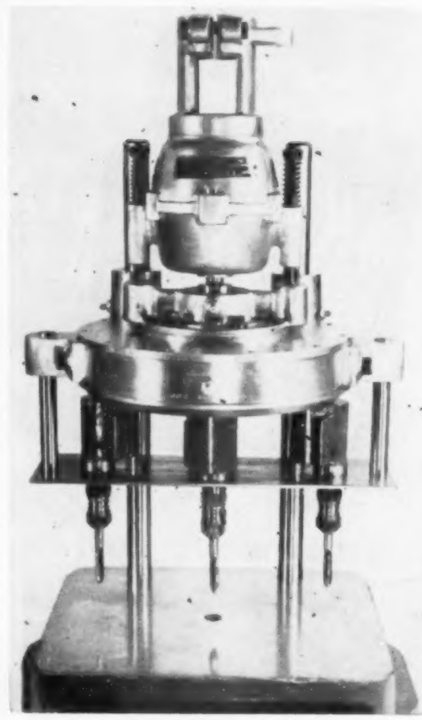
The National Jet Company will feature their Model No. 1 drilling machine, a super-sensitive tool designed for drilling of extremely small holes. This tool will be complete with accessories and attachments.

Also exhibited will be the bench model "Peri Drill", also for drilling microscopic holes. This tool is unique in that it employs neither a conventional spindle nor chuck. Said to be capable of drilling holes in the 0.001—0.002 in. diameter range on a production basis. Booth No. 1162. T-4-205

For further information, use Reader Service Card. See pages 129-130.

Adjustable Tapping Head

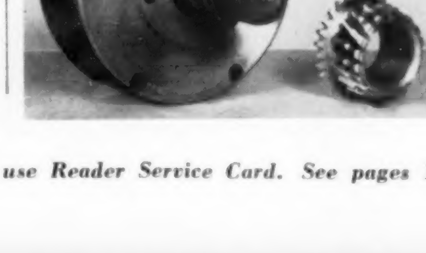
Flexibility in drilling tapping parts with hole sizes up to and including 5/16 in. in steel, on any type drill press, is provided with the convertible Ettco-Emrich adjustable-spindle Multiple Head, available with 2, 3, 4 or 5 spindles. Rapid and accurate spindle adjustments can be made from 1 1/16 in. minimum to 7⅝ in. maximum center distance. Spindles can also be located at any point within a 3 5/16 in. diameter circle.



With templates, it is a simple matter to locate spindles accurately for a given hole combination and to change their location swiftly from one drilling or tapping operation to another. Together with the bed plate, components are tied together like a punch and die, therefore always maintaining inbuilt accuracy and lineup. This unit, by Ettco Tool Co., Inc., will be shown for the first time at the A.S.T.E. Show, booth No. 732. **T-4-5**

Diaphragm Arbor

Shown in booth No. 435, by N. A. Woodworth Company, will be the Woodworth Diaphragm Arbor. Incorporating a novel principle of expansion, this arbor acts in reverse of that of a spring collet, expanding the O. D. to tightly and accurately grip parts having bored or ground holes. **T-4-12**



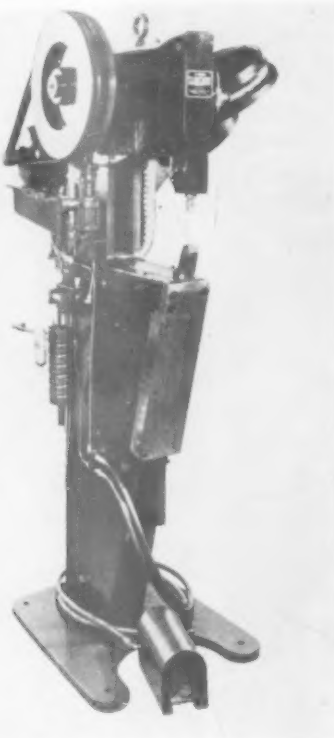
Rotary Drill Rod Rack

Shop efficiency is increased by the F-G-M drill rod rack which provides accessible, compact and orderly storage for the various sizes and kinds of drill rod. Illustration shows a unit of 13 compartments, each approximately 1½ in. wide, made by using extra dividers. Maximum utility of floor space is obtained with a minimum requirement for aisle and "draw-out" space.

The entire capacity of the rack can be brought to one point by merely rotating the rack. Mounted on ball bearings, it will not bind or sag even when fully or unequally loaded. The rotating design makes the rack ideal for use in corners. This unit is also excellent for storing welding rods or dowels. To be exhibited in the Frick-Gallagher Mfg. Co., booth No. 631. **T-4-179**

T-J Underfeed Clinchors

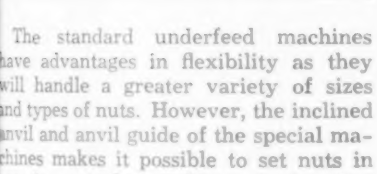
An Underfeed Clinchor, available in standard model with vertical anvil and anvil guide, and a special model with inclined anvil and anvil guide, will be exhibited by the Tomkins-Johnson Company. These machines are designed to automatically feed and set standard square neck cased nuts, and may also be furnished for handling floating type cased nuts and various sizes of Fabristeel nuts.



The standard underfeed machines have advantages in flexibility as they will handle a greater variety of sizes and types of nuts. However, the inclined anvil and anvil guide of the special machines makes it possible to set nuts in certain parts that could not be handled on the standard model, because of the restricted clearances in the parts. To be demonstrated with other T-J equipment in space No. 971. **T-4-150**

"Safe-T" Hammers

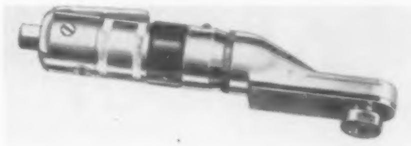
The gilding metal "Safe-T hammers by Univertical Machine Company, is a bronze hammer designed to be used in place of copper or brass hammers, where it is desired to strike a hard blow without injuring delicate machined surfaces. It is particularly applicable in the manufacture of precision machinery, tools and in die casting plants where product requires careful craftsmanship. Booth No. 542. **T-4-123**



Electrode Dresser

Among tools to be exhibited by Aro Equipment Corporation, will be an air-powered Electrode Dresser, a recent addition to the Aro line.

Developed in collaboration by nationally known manufacturers who use multiple welding equipment, this tool develops a cutting speed of 1200 rmp, said to have been proven most satisfactory not only for proper dressing of electrodes but also for increasing the number that can be dressed in a given interval of time.

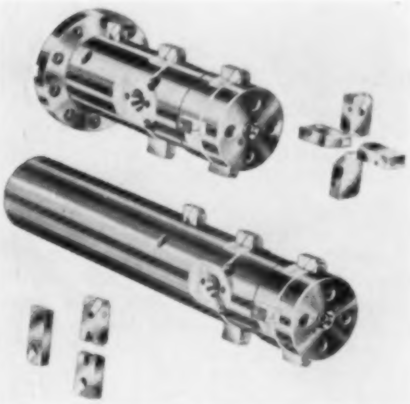


This tool, which will be demonstrated in booth No. 741, should be of special interest to all manufacturers using multi-point welding machines. **T-4-21**

Grinding and Polishing

Hammond Machinery Builders will exhibit a most complete line of metal finishing machinery, including wet and dry abrasive belt machines, and polishing and grinding machines. The latter include the Hammond carbide tool and chip breaker grinders. Booth No. 725. **T-4-21A**

Tooling Service by G & L



The complete tooling service available through the Davis Boring Tool Division of the Giddings & Lewis Machine Tool Company will be attractively shown in booth No. 230. Many important items of recent development will be demonstrated by the G & L engineering and sales staffs.

Among these tools will be a wide range of Super micrometer stud boring tool sets, and carbide planer and vertical boring and turning mill tools which have been added to this wide range of tooling.

For the interest of tooling engineers connected with the railroads, there will be introduced the Davis line of high production precision railroad car wheel boring tools. Inserted blade adjustable reamers, designed for longer life, now manufactured by the Davis Boring Tool Division, will also be introduced at the Show. The complete line of Davis standard and special tooling will likewise furnish an important background for the interest of tool engineers who attend the ASTE Exposition. T-4-17

Production Contour Saw

Boice-Crane Company, space No. 1139, will exhibit its low-cost combination Contour Saw and Band Filer, a versatile tool designed to up production on short-run production parts, irregular-shaped stacked parts and stampings, templates, spiral parts, form and trimming dies as well as a wide variety of tool and machine components.

A chart, mounted on the machine gives the correct speeds for all operations for which the machine is designed, and for all materials including steel, non-ferrous metals, glass, and plastics. In demonstration during the Exposition. Also shown will be Boice-Crane's Helmet Head Drill Presses and Tapping Machines, designed for heavier duty precision work. T-4-62

The Blue Book

Editorial features recently added to Machine and Tool Blue Book will be presented at the booth of Hitchcock Publishing Company, space No. 548. Issued monthly since 1906, this publication covers the metalworking industry in the U.S. Methods of selling Latin American and other world markets through the facilities of the monthly "Revista Industrial"—Spanish and Portuguese editions—and Hitchcock's annually issued Export Sales Catalogs will also be described by attendants. T-4-62A

Grinder by Boyar-Schultz

Boyar-Schultz Corporation will feature Model 6-12 Surface Grinder, a sturdy, well-built machine tool designed to handle a wide range of the work that ordinarily might go to larger machines. Fine materials and expert workmanship are combined in making it a grinder that will maintain its accuracy over a long period of daily use.

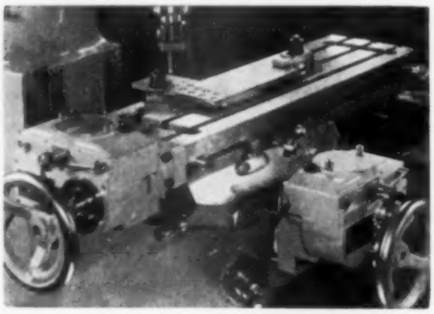
Also, by Boyar-Schultz, will be a display of small tools and accessories including screw machine and turret lathe tools, holders and chucks, Booth No. 133. T-4-3

Automatic Gear Chamfering

Modern Industrial Engineering will introduce the "Burr Master" gear burring and chamfering machines. Designed to chamfer both sides and the root of the teeth on external and internal gears and splines, these machines require no clamping. Location is automatic while the machine runs continuously. Booth No. 30. T-4-186

Coordinators by Benzon

The basic idea of making records on cylinders and putting them on a machine to reproduce sound is broadly ap-



plied to the "Coordinator Method" developed by Benzon Machine Company.

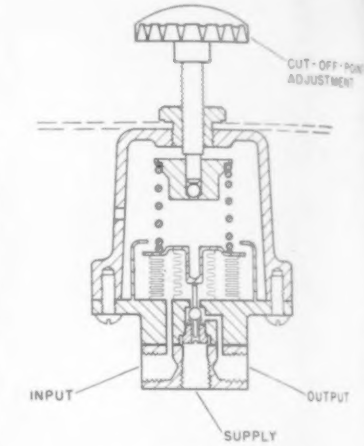
Designed as attachments for machine tools to provide a method for positioning work in relation to cutting tools, their Coordinators, when geared to the traverse screws, reproduce measurements which have been recorded on micro-patterns—that is, records.

The coordinators—shown mounted just ahead of the traverse hand wheels—are mechano-electrical devices, without complicated circuits or electronics. The records are made on a small portable unit. A complete pattern of hole locations can be recorded simply and quickly, and when the traverse screws are not sufficiently accurate, will compensate for inaccuracies. Visit space No. 6 for this interesting display. T-4-1

Indicate A-4-116-1

Gages by Moore Products

Exhibited by Moore Products Company will be a Pneumatic Relay for use with air-electric switches and other equipment requiring accurate high-speed operation. This relay is used in the Moore automatic air gage.



A number of these relays have been used in connection with Moore air gages to operate signal lights and sorting mechanisms. When used with a high magnification type Moore pneumatic comparator gage—0.0004 in. full scale—and a commercial pressure switch, this relay will operate a signal light on a dimension change said to be as small as two millionths of an inch.

Tests on repeating accuracy have shown that this relay operates, after 8½ million cycles, with a deviation of only 2 to 4 millionths. Space No. 301.

T-4-119

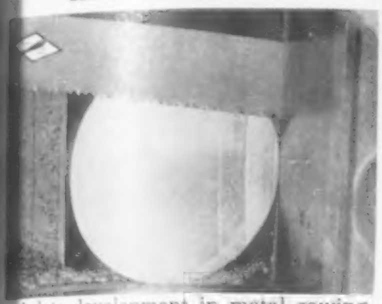
Hydraulic Motors

Hydraulic motors will be exhibited by Gerotor May Corporation. These motors, which provide an efficient method of converting hydraulic power into rotary power, are offered in sizes up to 8.7 HP.

Having flat torque and variable-horsepower characteristics, the power output is proportional to the shaft speed as long as the operating pressure remains constant. Speed and direction of rotation can be easily and precisely controlled. Shown with other Gerotor May hydraulic devices in space No. 655.

T-4-134

"Red Rocket" Saws



A late development in metal sawing, the Barnes Red Rocket power blade features safety and performance dependability. It combines flexibility and toughness, will stand abuse, reduces breakage and minimizes shattering. Available in all power blade sizes. Featured by W. O. Barnes Co., Inc., space No. 339. T-4-96

10-in-1 Tool Holder

Acme Tool Company will feature the Universal Tool Holder, which is said to replace 10 single-purpose tool holders. It may be used as a right-hand, left-hand or straight-in tool, or at any angle desired by the user. It can further be used for boring and internal threading.

Also, by Acme, will be shown tool makers specialties and tools for inspection, checking setup work—all time saving "tools of today". Booth No. 766. T-4-96A

Du-Matic Drill Head

Shown for the first time at the ASTE Show will be the Dumore Du-matic drill head, said to do for drilling what the automatic shift has done for driving. Ideal for production drilling of small holes, the Du-matic is actually a high-speed motor and rotary air compressor mounted on the same armature shaft. Equipped with a Jacobs chuck, the ball bearing motor supplies power for drilling holes from No. 80 to No. 15, or up to 0.180 in.

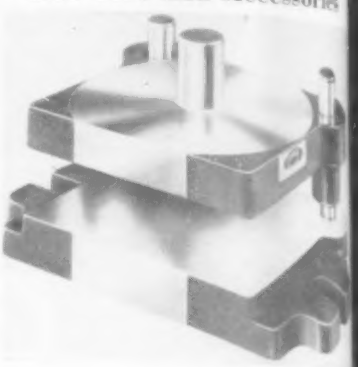
The self-contained compressor develops the cushioned power for drill advance and drilling pressure, and the novel design affords accurate control of drilling pressure and drill feed for all drillable materials from soft plastics to tool steels. Machine can be connected for both complete automatic cycling or semi-automatic operation. Booth No. 959. T-4-133

Expanding Mandrels

The Champion precision expanding mandrel, by Western Tool & Mfg. Co., is designed for use on any job where precision and time-saving are of paramount importance. Advantages include positive drive, quick change of work, guaranteed concentricity and the elimination of arbor pressing and colleting.

Made for use on lathes, shapers, planers, grinders and milling machines, this expanding mandrel is said to be entirely novel in principle. It is made in two parts from oil-hardened tool steel. The sleeve moves on the arbor to provide a range of only 0.010 in., thus assuring extreme accuracy. It closes at 0.003 in. under and opens at 0.007 in. over nominal size with a positive stop on the arbor to prevent overstrain of sleeve, and holds tolerances of less than 0.0001 in. runout. Made in standard sizes from ½ in. through 3 in. diameter graduated by 1/16ths. Special sizes to order. Booth No. 1118. T-4-

Die Sets and Accessories



Danly Machine Specialties, Inc. will exhibit an unusually broad line of Danly die sets and accessories. The die set illustrated, which is typical of the line incorporates hardened, ground and tapped guide posts and bushings which together with squareness and parallelism, contribute to the dependable accuracy of these tools.

Also, by Danly, will be shown die accessories including die springs, precision dowel pins, knurled socket head cap screws and stripper bolts, and the Danly Kwik—Klamp toggle clamps. Space No. 850. T-4-71

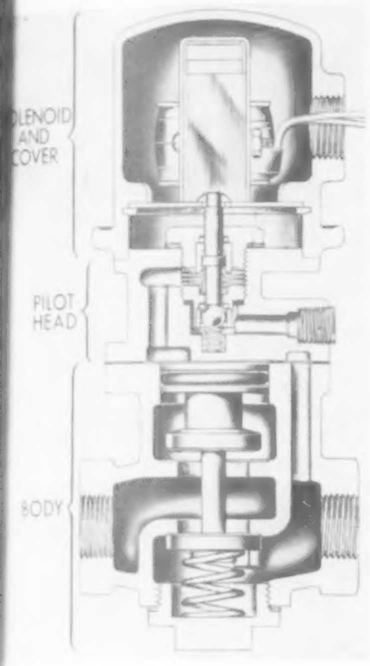
Balancing Tool

R. B. Annis Company's exhibit at the ASTE Exposition, space No. 1056, will contain the latest version of their Precision Dynamic Balancing Machine. The Model M2-S-40 machine, pictured employs a photoelectric scanning arrangement along with a cathode ray tube which gives simultaneous readings of both amount and position of unbalance.

The recording meter attachment which may be added to any existing Annis balancing machine, gives a permanent record of the balance condition of rotors as received, and time required to balance. Production speed and down time are also shown. T-4-71

In-Line Valves

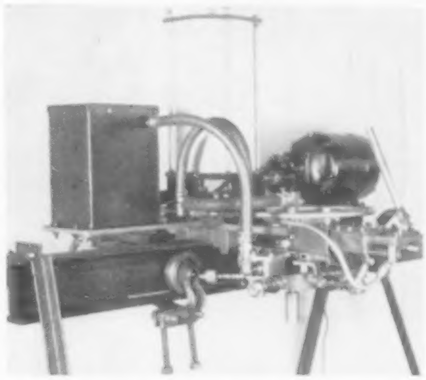
How combinations of standard Ross ve bodies and heads make possible r 500 different valve applications will highlighted by the Ross Operating lve Co., booth No. 139. The interangeability of parts in their series of ull-Flo" in-line valves implies that rts inventory is kept at a minimum. e illustration shows how a standard way solenoid operated valve is comsed of three basic units.



Both normally-open and normally-closed models will be shown in sizes from ¼ to 1¼ in. for straightway and 3-way applications; also, solenoid valves for either AC or DC current. Explosion-proof models will also be on display, as well as special modifications for auxiliary push-button operation and for vacuum applications. **T-4-164**

Conveyor Lubricators

Cox Engineering & Sales Co., space No. 203, will exhibit the Freiman automatic trolley conveyor Lubricators, which actuated by the moving conveyor wheels. The hubs of the passing pulleys engage the guide cups of the pumping units and thereby cause rotation of the lubricator head. During the rotation, the pumping units are forced inward and measured amounts of grease are forced into the fittings at the ends of the wheel hubs.



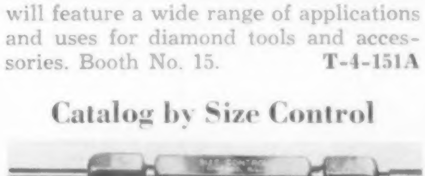
Hydraulic cylinders mounted on each head are operated when the pumping unit is directly opposite a wheel, causing a quick movement of the pumping unit. The lubricator will handle all types of greases or oils and will lubricate any conveyor where wheels are 8 in. or more apart.

Also shown will be the Freiman Power-Flare, a portable power unit designed to flare all types of tubing, especially steel for hydraulic service from ⅜ to 2 in. O.D. in any wall thicknesses. May be used for all types of fittings. **T-4-151**

Diamond Tools

The Cleveland Industrial Tool Corporation will exhibit their line of Citco solid diamond tools, also, the Citco Hydraulic Diamond Turner. The exhibit will feature a wide range of applications and uses for diamond tools and accessories. Booth No. 15. **T-4-151A**

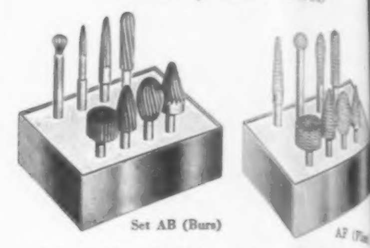
Catalog by Size Control



Size Control Company will have its latest No. 50 catalog on reversible plain and thread plug gages, centerless lapping machines, and a complete line of tungsten carbide and norbide gages. In addition to the economy of the reversible features, Size Control gages now offer the additional economy of long wearing tungsten carbide and norbide materials. Additional features of root relief on major ring thread diameters, truncated set plugs, convoluted and lapped thread gages with chip groove, are also described. Booth No. 714.

T-4-174

Rotary File Sets



The Martindale Electric Compa will show the eight most popular shap and sizes of both Martindale Burs an hand-cut Files, both offered convenien ly boxed as "Utility Sets." Shown i booth No. 1147. T-4-

Ampco Metals & Alloys

In keeping with the cost-cutting theme of the Tool Engineers Industria Exposition, Ampco Metal, Inc., wi stress the economies that can be achiev ed through the proper selection and ap plication of Ampco metal in its variou grades.

To emphasize these economies, they will display dies and punches made from Grade 24 Ampco Metal along with work formed and drawn on these dies. They will also show guide post bushings made from Grade 18 alloys, and boring bar wear strips made from Grade 21 Amp co metals.

In addition, Ampco Metal will show typical examples of sand and centrifugal castings, extruded hollow and solid bar stock, rolled sheet and plate, forgings arc and resistance welding electrodes Booth No. 1131. T-4-201

Toolgraph Chart

The exhibit by Illinois Tool Works will include the Toolgraph Chart, produced by the Illinois hob lead checker and recorder. This chart is a graphic record showing the exact location of each tooth on a hob in relation to all other teeth and in relation to a desired theoretical lead helix.

Showing these relations in chart form reveals the pattern, as well as the magnitude of any errors, more clearly than the tables of indicator readings formerly supplied with hobs. Booth No. 756. T-4-

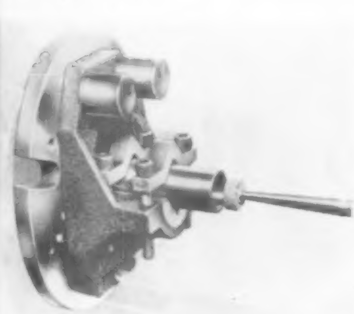
Twin-Wheel Grinder

With both wheels within the operator's working area, it is "but a step from rough to finish grind" with the twin-wheel wet or dry Carbide Tool Grinder, manufactured by the Standard Electrical Tool Co. Further space saving is effected by the frontal position of the wheels, which permits the machine to be located against a wall.

V-belts or wheels may be quickly changed, and compensation for wheel wear is effected by just one moving part—turn a crank to adjust the wheel for minimum table clearance. Stationary, tilting tables, graduated in degrees, are rigid at all times and require no maintenance. Copious coolant supply, to spouts at each wheel without spray or splash, is controlled by a single 3-way valve, while exhausts for dry grinding are built in. Booth No. 965.
T-4-6

Versatile Work Holder

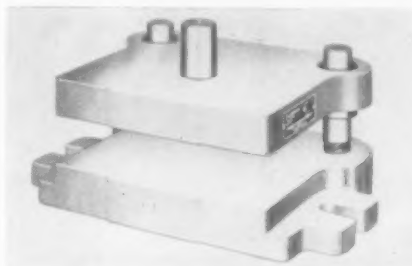
Lassy Tool Company, booth No. 556, offers a Work Holder designed to provide quick, accurate setups on lathes, grinders, jig borers, milling machines and drill presses.



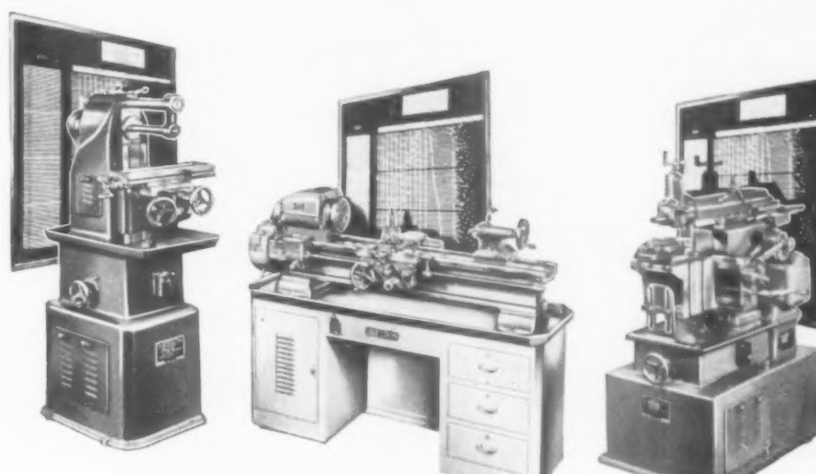
Also, by Lassy, a universal tap guide, for use on lathes, drill presses or as an extension tap wrench. With it, work can be drilled on a drill press and without disturbing the setup, the drill can be removed and the tap guide inserted and the hole tapped accurately. In the same way, the tap guide can be inserted in a lathe and work tapped under power.
T-4-200

"Standard" Die Sets

Standard Die Set Manufacturers, Inc., announce lately adopted manufacturing refinements which contribute to the quality of "Standard" Die Sets, such as illustrated, and further improve their



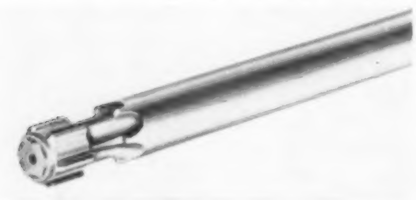
performance on the job. All "Standard" Die Set plates are now stress relieved before finishing, producing a more uniform material that can be more readily drilled, tapped, or milled. All holes are bored to insure uniformity of the hole centers and full contact with posts. Deep freezes of posts and bushings prior to assembly. This relieves strain, and permits the posts to be assembled parallel to each other and at 90 deg to face of die holder. All cast sets are made with GC Type Meehanite, providing the greatest uniformity in density within the thickness range to which punch and die holders are made, and further providing tensile and shear strengths of 40,000 lbs. A complete line of Standard die sets will be on exhibit in space No. 926. **T-4-53**



For further information, use Reader Service Card. See pages 129-130.

Shell-Type Reamer

The Staples Tool Company, will exhibit a complete line of Staples circular and single point carbide-tipped metal cutting tools at the ASTE Industrial Exhibition, space No. 745. One of the features of the Staples' exhibit will be a display of the newly developed Staples carbide-tipped shell type Expansion Reamers—illustrated—which, to compensate for tool wear, is expanded by driving the shell up the tapered arbor. Uniform parallel expansion the full flute length is maintained, permitting adjustment of the tool diameter to a stated 0.0001 in. accuracy. T-4-77



Metal Working

Metal-Working, published by the Sutton Publishing Co., Inc., is a publication serving the metal-working field Get better acquainted with this magazine in booth No. 558. T-4-77A

Tools by Pratt & Whitney

Pratt & Whitney Division, Niles-Bement-Pond Co., will exhibit in two booths at the ASTE Show in Philadelphia. In space No. 815 will be displayed a complete line of precision cutting tools and precision gages. As a high spot among the latter will be the P & W Model F Air-O-Limit Comparator—illustrated—and the Duplex Indicator, the latter a recent development for 3-station gage application.

In space No. 632 will be featured the latest in Kellerflex flexible shaft machines and the Diaform wheel-forming attachment which is said to form diamond grinding wheels to a "tenth" accuracy. As an added attraction Pratt & Whitney will have a miniature conveyor system automatically operated by a P & W Synchro Timer, a remote control timing device that directs, classifies or sorts almost anything produced continuously.
T-4-55

Speed Lathes by Schauer

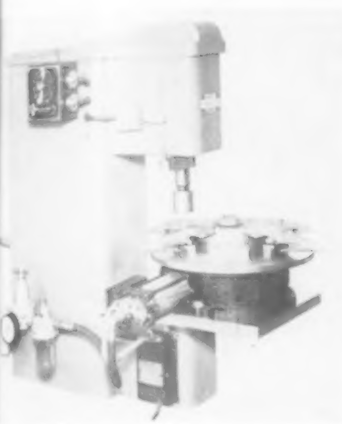
Schauer Mfg. Corp., space No. 848 will exhibit a line of speed lathes featured among which will be the Model VA3BC-V, a variable speed head with speeds ranging from 100 to 4800 rmp. The lathes may be had with vacuum holding fixtures as well as in collet types. T-4-113

Form and Cut-off Tools

Arthur A. Crafts Co., Inc., will present a line of circular form and cut-off tools made either of solid carbide, or tipped for requirements of production runs. These cutters feature closest precision standards even in most complicated forms, and guaranteed uniformity. Booth No. 229. T-4-156

The Hapco Press

Exhibited by Hy-Air Products Company, space No. 951, will be the Hapco Press, an air-operated, oil-hydraulic press equipped with an air-operated dial index table automatically controlled by a preset timer, solenoid valve and micro switch.

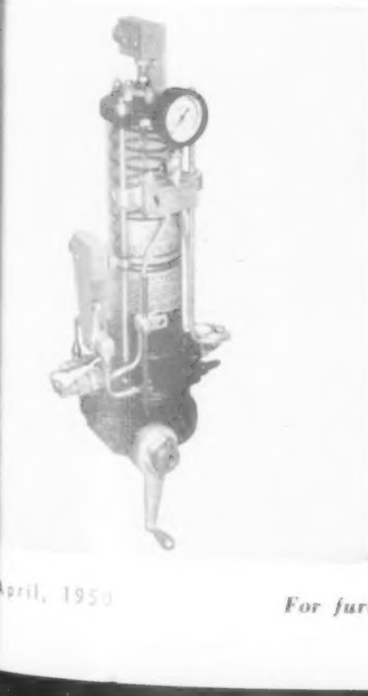


Pressure, stroke and speed of cycling are all accurately adjusted up to the maximum capacity, and there are only two moving parts—the intensifier piston, the hydraulic piston and ram. All parts are contained in the unit housing. Standard capacity are 2½ and 5 ton with 2 or 5 in. strokes. **T-4-82**

Automatic Lubricator

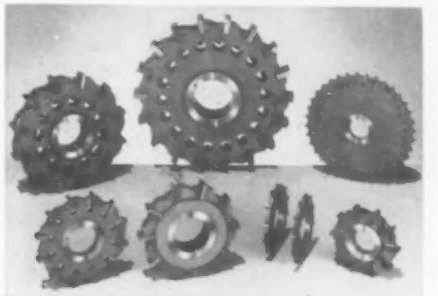
Featured by Trabon Engineering Corp., space No. 1116, will be the Model 3000 Lubricant Pump, one of many manufactured by this company. Designed for automatic mechanical drive and used primarily with Trabon oil and grease lubricating systems, the unit is intended for use with small and medium machinery having bearings of average size.

Installed on such equipment as crane trolleys, shears, levelers, reels, presses and small mills, its fully hydraulic and progressive action is said to make it impossibe to skip or under-lubricate a bearing. A single indicator tells that the system is working properly. **T-4-110**



Slotting Cutter

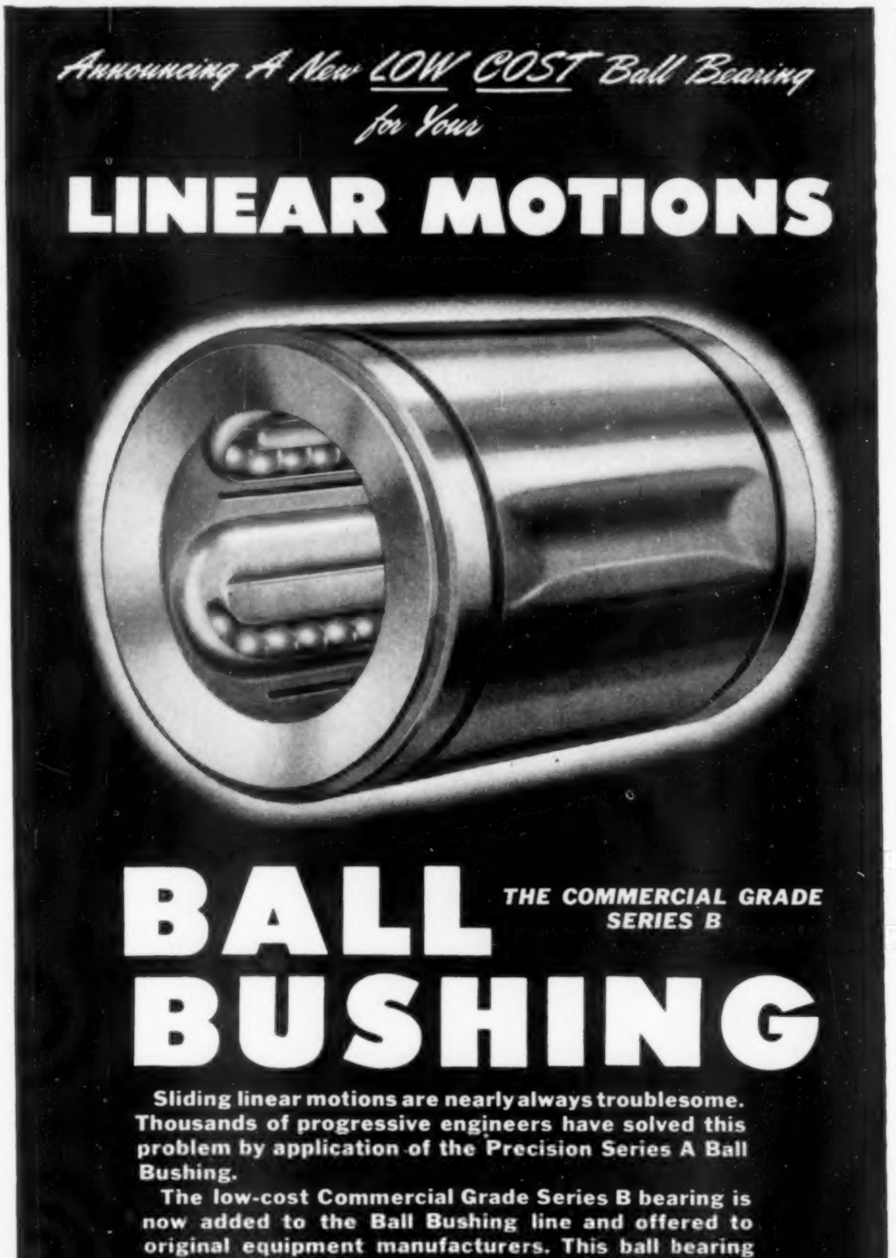
Lovejoy Tool Company, Inc., will feature their Type "S" inserted blade slotting cutter in action at the ASTE Show.



This cutter is said by the maker to embody genuine "cost cutting" points in that its inserted blades are the inexpensive standard carbide blanks made by all tungsten carbide manufacturers.

The blanks are mechanically held by a simple wedge, making them easily adjusted, easily ground, and inexpensive to maintain. The standard sizes range from 3 in. dia. by $\frac{5}{16}$ in. wide, with 12 blades, up through 8 in. dia. x 1 in. wide, wth 18 blades. The large number of blades and rigid construction of these cutters should classify them as cost cutting production tools. Space No. 646.

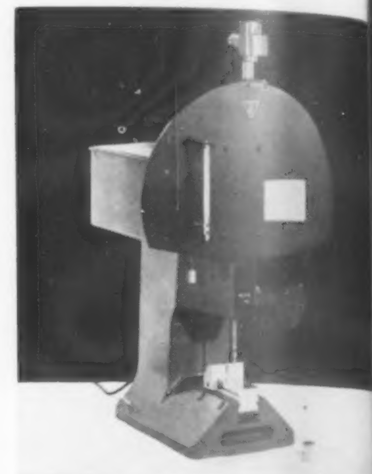
T-4-160



Indicate A-4-124-1

Inspection Tools by B&L

The Bausch & Lomb Optical Company announces that it will introduce a 3 in. Thickness Gage at the ASTE Show, space No. 407. Capable of readings direct to one ten-thousandths of an inch, the instrument is designed for extremely accurate, rapid control in production speeds.



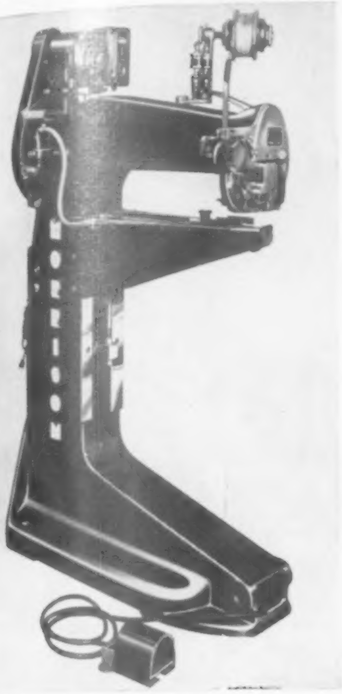
Readings are taken from a glass viewing screen on which magnified images of the scales are shown. The screen shows a vertical scale reading to hundredths and a horizontal interpolating scale reading directly in one ten-thousandth of an inch.

In addition, B&L will exhibit a toolmaker's microscope, Para-Plane gages, a contour measuring projector, shop microscopes, stereoscopic wide-field microscopes, wide field tubes, Brinell microscopes, and a work shop contour projector. T-4-1??

The "Springmaster"

The Cycloid Corporation will demonstrate the Springmaster, a tool that converts a drill press into an efficient spring making machine. Mounted on any drill press of ½ in. capacity, it coils springs from 6 ga. to 28 ga. wire, outside diameters from $\frac{1}{16}$ to ⅝ in. Pitch may be varied while the machine is running. Booth No. 23. T-4-1??

Metal Stitching Display



Acme Steel Company's Model N2C-25 Acme-Morrson metal stitcher will be on demonstration in space No. 234. This machine fastens metal to metal, or to non-metalic materials, by means of metal stitches formed from a continuous length coil of wire. As the wire punches its own holes, no pre-punching or drilling is necessary. This obviates matching of holes in matching parts as well as the usual minute inspection. This machine is therefore a real time saver in fastening varous materals. **T-4-155**

Bench Gage by Bryant

The Bryant Chucking Grinder Company will feature the Bryant No. 11 Bench Gage, a tool for quality control and for the fast, accurate checking and classifying of internally and externally threaded parts. Users will find savings in labor, cost of gages for inspection and, through control, a saving in materials. Booth No. 3 **T-4-175**

Whiteprinting Equipment

In booth No. 801 will be demonstrated, continuously, five various sized Bruning Whiteprinters, including the Volumatic Model 93, illustrated. This whiteprinting equipment, by Charles Bruning Company, will produce a wide variety of direct positive Bruning whiteprints from any tool, engineering or line drawing as well as from anything written, printed or typed on translucent paper, cloth or film. They will also produce direct copies of any opaque or two-sided subjects. In addition, several popular Bruning drafting supply items will be exhibited in actual use. **T-4-13**

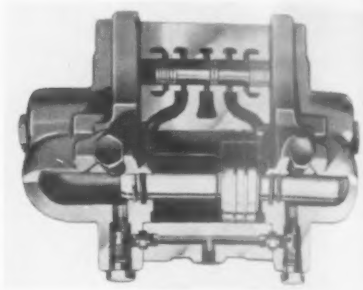
Kennamatic Tools

Kennametal, Inc., will highlight the improved Kennamatic tools which embody the features of solid, vertically-positioned, mechanically-held, indexable Kennametal inserts. These tools have solid heat treated alloy steel shanks —not split for clamping as heretofore— that resist deflection under heavy cutting loads.

The solid backing in direction of cutting forces insures more accurate indexing of insert, while a broached hole for fully enclosed inserts gives greater strength and rigidity. These tools, among the many types to be displayed by Kennametal, are available in all styles of Kennamatics—round, square and triangular inserts. Space No. 914. **T-4-137**

Boosters and Valves

Exhibited by Racine Tool & Machine Company, space No. 222, will be the Racine Pressure Booster. Available in 5 ratios, this unit boosts hydraulic pressures up to 5000 psi. without an increase of horsepower over that required to operate the pump supplying the initial flow of oil. It can be used with either constant or variable volume pumps.



Also exhibited will be balanced piston sleeve-type valves for operating pressures of 1500 psi. Available in foot or panel mounted designs for manual, electrical or hydraulic operation and control. T-4-126

Gear Sound Tester

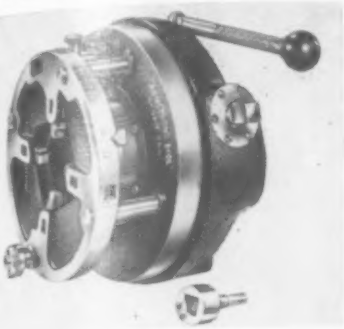
The function of the "Red Ring" Gear Sound Tester, to be shown at the exhibit of the National Broach & Machine Company, is to study gear noise and its causes but especially to segregate gears which, due to accumulated errors, will prove objectionably noisy in operation. Correcting such gears before they are assembled saves the time, otherwise required, to tear down the noisy assembly.

The machine illustrated, to be shown in booth No. 601, is built for both external and internal gears and is especially suitable for planetary gear assemblies such as those used in automatic transmissions.

It is built in two sizes, one to accommodate gears up to 14 in. in diameter and the other for gears up to 24 in. Tests can be run at four speeds in either direction and the gears under test can be loaded by means of a hand brake. It can be equipped for air clamping to speed loading and unloading the work.

T-4-50

Portable Pipe Threader

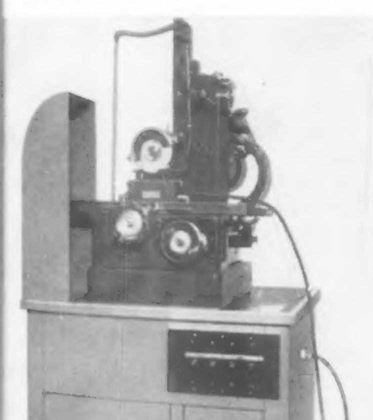


Armstrong Brothers Tool Company will exhibit a novel portable pipe threader—Model No. 165—designed to thread pipes from 1 to 2 inches. A power tool, driven by a ½ in. electric drill and weighing only 26 lbs., this pipe threader is readily portable for bringing the tool to the work. Furnished with high speed steel chasers. Booth No. 1047.

T-4-183

Profile Surface Grinder

The "Dupliform", a profile surface grinder by the Tool Division of Airborne Accessories Corporation, incorporates a profiling wheel dresser which permits dressing of wheels directly from a sample part when grinding either external or internal portions of dies, tools or gages.



The dresser includes a means of correcting the form of the profile follower said to correspond exactly with the contour of the diamond point, regardless of its shape or variation from symmetry. This compensation of the tracer nose can be repeated as often as is necessary in the processing of the tool to final size.

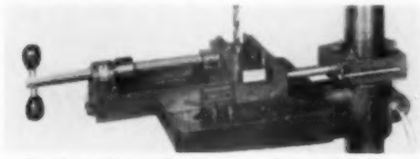
This machine, which is said to split tenths while yet applicable for general surface grinding and heavy rough cuts, will be on exhibit in space No. 1122.

T-4-100

For further information, use Reader Service Card. See pages 129-130.

Safety Drill Press Vise

Shown in improved form for the first time at the ASTE Show, booth No. 1152, will be the Universal Safety Drill Press Vise with column adapter, by the Universal Vise & Tool Co.

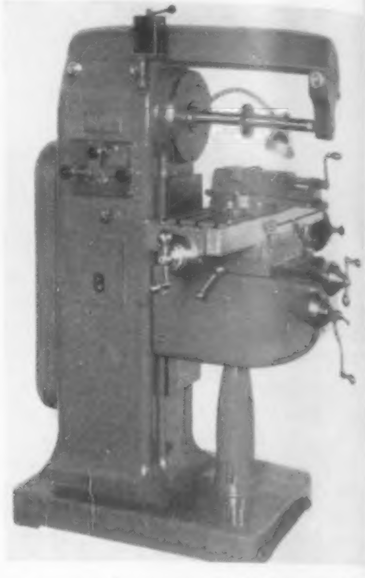


Designed to fasten to the column of a drill press, these vises can be left free to swing to any spot on the table for miscellaneous drilling, or, they can be rigidly secured to the column for production drilling. When desired, the entire unit can be swung clear of the table, or, the vise may be detached for use on other equipment.

The vise has full 6 in. jaw opening, with jaws 1½ in. deep x 4 in. wide. Action is by means of a quick-acting position lock that operates with a turn of the handle. The column adapters, which provide against accidents when drilling, are adjustable from 1⅝ to 4 in. column diameters. T-4-16

Horizontal Milling Machine

Shown by Index Machine Company, booth No. 1115, will be the Model 60 Index plain horizontal Milling Machine. Rugged and accurate, and designed for low maintenance costs without sacrifice of versatility, its big 9 x 40 or 46 in. table brings it close to the capacity of the light No. 2.



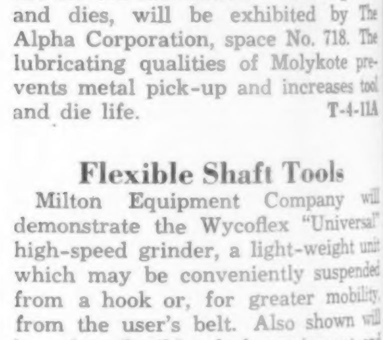
Among features of design are large micrometer dials, an enclosed elevating screw and a novel face plate mounting for the spindle mechanism. Arbor rigidity is enhanced by a rugged overhead support arm. T-4-11

Hi-Pressure Lubricant

"Molykote", an extreme bearing pressure lubricant said to maintain its lubricating properties at bearing pressures exceeding the yield points of metals, and therefore finds increasing use for the lubrication of forming tools and dies, will be exhibited by The Alpha Corporation, space No. 718. The lubricating qualities of Molykote prevents metal pick-up and increases tool and die life. T-4-11A

Flexible Shaft Tools

Milton Equipment Company will demonstrate the Wycoflex "Universal" high-speed grinder, a light-weight unit which may be conveniently suspended from a hook or, for greater mobility, from the user's belt. Also shown will be other flexible shaft equipment and accessory tools. Booth No. 619. T-4-154



THE TOOL ENGINEER'S *Service Bureau*

FREE BOOKLETS AND CATALOGS CURRENTLY OFFERED BY MANUFACTURERS

Grinder

Folder pictures and describes company's "friction-matic" wet tool grinder, especially adaptable to use for hand tools. Specifications and prices for the six models available are included. **Boice-Crane Co., 930 Central Ave., Toledo 6.** L-1

Carbide Dies

Six case histories are reported by different users presented as concrete examples of advantages of carbide dies in illustrated booklet; also description of companies facilities for producing dies. **Lincoln Park Industries, Lincoln Park 25, Mich.** L-2

Carbide Tools

Comprehensive Catalog VR-440, 92 pages visually indexed, contains reference material on carbide and cast alloy products; establishes 10 carbide grades simplifying selection of proper grade; includes advanced designs, new products. **The Vascoloy-Ramet Corp., 800 Market St., Waukegan, Ill.** L-3

Plastic Extrusion

Recently published third edition of "Tenite Extrusion" now available; 28-pages of up-to-date information on equipment, choice and handling of material for continuous extrusion of Tenite I and II (cellulose acetate and cellulose acetate butyrate plastic). **Tennessee Eastman Corp., Kingsport, Tenn.** L-4

Lubricant

Booklet discusses causes, costs and cure for "stick-slip" and "chatter" in certain machine tools, and the effect of metal-wetting, adhesive and anti-corrosive lubricant on these problems. **Sun-Oil Co., 1608 Walnut St., Philadelphia 3.** L-5

Precision Facilities

Folder illustrates company's precision facilities, giving detailed explanation of ability to do flat and cylindrical lapping, to within claimed millionths, to fit exact specifications of the trade. **Acme Industrial Co., 218 N. Laflin St., Chicago 7.** L-6

Die Nibs

Supplement D-4 describes and lists, with specifications and prices, recent additions to line of standard stock die items—rough cored carbide header die nibs. **Carboloy Co., Inc., Detroit 32.** L-7

Bushings

Dimensional and application drawings, photos, design data, special features and advantages covered in "Anchor Bushing" catalog; size chart and ordering information included. **The Hi-Shear Rivet Tool Co., Hermosa Beach, Calif.** L-8

Oil Purification

Quench oil purification problems and solutions treated in two case history bulletins—"Oil Quenching" and "Case History of the Mechanics Universal Joint Division"; describes details of application and performance of installations used. **Honan-Crane Corp., 676 Wabash Ave., Lebanon, Ind.** L-9

Motors

Two-page folder, C-130, shows three classes of explosion-proof motors, emphasizing those made for application in hazardous locations; features details of corrosion-resistance protection in motor construction. **Reliance Electric & Engineering Co., 1088 Ivanhoe Rd., Cleveland 10.** L-10

Rotary Feed Table

Bulletin T-25, on mechanically and hand electrically operated rotary feed tables, gives detailed information on their use for faster feeding and lower costs. **The Bellows Co., 222 W. Market St., Akron, Ohio.** L-11

Perforating

Bulletin 7 presents, in words and pictures, company's perforating method for television, radar and radio chassis, stamping press setup. **Wales-Strippit Corp., 324 Payne Ave., North Tonawanda, N. Y.** L-12

Micrometers

Folder describes and illustrates line of satin chrome micrometers for precision measuring, stressing recently incorporated features eliminating glare, resisting corrosion, etc., **The L. S. Starrett Co., Athol, Mass.** L-13

Finishing

Illustrated Catalog 50 covers company's recently developed Model K series of rotary automatic finishing machines, featuring fast indexing, variable work spindle speeds and variable dwell time; includes general specifications, economic advantages. **Hammond Machinery Builders, Inc., 1629 Douglas Ave., Kalamazoo, Mich.** L-14

Precision Boring

Folder 31101 describes manual and hydraulically operated universal boring fixtures for precision boring machines, stressing flexibility; construction features and specifications. **Ex-Cell-O Corp., Detroit 32.** L-15

Spindles, Internal Grinding

Seventy-two page Catalog No. 57 to aid user in selecting correct internal grinding spindle for given application; indexed illustrations and dimensional data cover company's line. **Pope Machinery Corp., Haverhill, Mass.** L-16

Coolant Base

Folder describes Safco 770 compound, all-purpose coolant base; lists advantages for both grinding and machining; includes recommended dilution chart for this water soluble product. **Swan-Finch Oil Corp., RCA Bldg., West., New York.** L-17

Pumps

Catalog 4900 illustrates line of oil hydraulic pumps and controls accompanied by description and specifications; also installation details and performance data. **Vickers, Inc., 1400 Oakman Blvd., Detroit 32.** L-18

Steel

Leaflet describes Ry-alloy ground flat stock, trade name for oil hardening tool steel for making dies, jigs, tools, stamps, etc.; stock sizes and prices listed. **Joseph T. Ryerson & Son, Inc., Box 8000-A, Chicago 80.** L-19

Processes

"Products and processes" describes company's five major groups—alloys and metals; chemicals; electrodes, carbons and batteries; industrial gases and carbide; and plastics. **Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17.** L-20

Lapping

Recent addition of 24 in. rotary lapping machine to company's machine tool line described in 4-page folder; price list included. **Taft-Peirce Manufacturing Co., Woonsocket, R. I.** L-21

Carbides

Chart of tungsten carbide manufacturers' grade recommendations for chip removal, wear and impact applications in accordance with industry's standardization committee. **Adamas Carbide Corp., Box 149, Harrison, N. J.** L-22

Hydraulics

Bulletin 150 incorporates discussion of "Hy-Power" hydraulics system, operating characteristics and operating cycle, applications, engineering and specification drawing and tables. **Hannifin Corp., 1119 So. Kilbourne Ave., Chicago 24.** L-23

Cutting Tools

Exclusive design features and advantages from production stand-point outlined in catalog presenting description, pictures and listings of line of carbide-tipped cutting tools. **Nelco Tool Co., Manchester, Conn.** L-24

THE TOOL ENGINEER, DETROIT 23, MICH.

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(Mark Key Number of trade literature, tools or advertisements)

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A—	L—	T—
A—	L—	T—

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Students are requested to write directly to manufacturers

Charts

Easy-to-read pressure and flow charts for air and hydraulic cylinders: data tables include theoretical cylinder thrust for various cylinder sizes; oil or air consumption. **Miller Motor Co.**, 4027 N. Kedzie Ave., Chicago 18. L-25

Packing, Rubber

Revised "Handbook on Synthetic Rubber Packings" available as reference book for design engineers and maintenance men, includes added material on packing standardization approved by JIC. **E. F. Houghton & Co.**, 303 W. Lehigh Ave., Philadelphia 33. L-26

Grinding and Finishing

"Step Up Production" booklet on use of abrasive belts in industry offers 36 pages of case history examples and technical data on grinding and polishing; techniques described for variety of materials. **Minnesota Mining & Mfg. Co.**, 900 Fauquier St., St. Paul 6, Minn. 6-27

Die Casting

Model 50 Cleveland universal high pressure hydraulic die casting machine described in detail in illustrated folder; with specification tables. **Cleveland Automatic Machine Co.**, Cincinnati 12. L-28

Metalworking

"Drawing Compounds for Metals" gives comprehensive coverage of metal drawing stressing importance of drawing compounds to increase die life and giving detailed recommendations for their selection; outlines, with drawings, cold or hot drawing operations. **Penola, Inc.**, 15 W. 51st St., New York 19. L-29

Cutting Tools

Recent 136-page catalog describes company's standard cutting tools, many special tools plus containing complete broach and fixture section; useful information and charts pertinent to metalworking included. **Continental Tool Works, div. Ex-Cello-O Corp.**, Detroit 32. L-30

Threading Attachment

Circular announcing threading attachment for lathes tells in words and pictures what tool will do, advantages and specifications. **Lehmann Machine Co.**, Chouteau and Grand Blvd., St. Louis 3. L-31

Chucks and Collets

Folder No. 7-1 contains detail pictures, drawings and specifications of various styles of quick change chucks and collets with special section dealing with chucks for horizontal operations; uses and possibility for speeding up production also discussed. **Scully-Jones and Co.**, 1915 So. Rockwell St., Chicago 8. L-32

Gages

Line of gages describes and illustrates gage line including thread plug and ring gages, concentricity, pipe thread, special toolmaker's gages and others; also contains section on charts of practical, every-day-used information. **Cadillac Gage Co.**, 20316 Hoover Rd. Detroit 5. L-33

Presses

Booklet outlines recently announced purchase plans for company's line of presses; six methods of deferred payment plan described in detail with down payment, interest rates, etc., stipulated. **E. W. Bliss Co.**, Toledo 7. L-34

Punch Presses

Diamond Multi-Max punch press described and illustrated with special emphasis on construction features and attachments; lists companies now using press and tells of their diversified applications. **Diamond Machine Tool Co.**, 3429 E. Olympic Blvd., Los Angeles 23. L-35

Metal Finishing

Brochure illustrates grinding and polishing equipment in use, explaining details and advantages. **Behr-Manning Corp.**, P. O. Drawer 808, Troy, N. Y. L-36

Shapers

Widely illustrated Catalog N-5 shows company's machines in many manufacturing and maintenance uses; dimension and specification data incorporated. **The Cincinnati Shaper Co.**, Hopple, Gerrard and Elam, Cincinnati. L-37

Ball Bearings

Miniature radial, pivot, thrust, angular contact and special to order ball bearings described and pictured in actual size (down to 2/16 in. OD) in Bulletin 49; design factors and variations, specifications and typical applications cited. **Miniature Precision Bearings, Inc.**, Keene, N. H. L-38

Inspection

Advantages of contour projector for optical inspection of parts by comparing enlarged image with tolerance chart, detailed in 8-page illustrated booklet; drawings and cut away view explain operation. **Industrial Optical Division, Eastman Kodak Co.**, Rochester 4, N. Y. L-39

Milling Machines

M-1670, picture-book type catalog describes special features, engineering points and unit construction of plain and duplex hydromatic milling machines; specification and dimensional drawings and tables included. **Cincinnati Milling Machine Co.**, Cincinnati 9. L-40

Arbor Presses

Bulletin No. 250 describes air operated ar[...] presses, available up to 18 tons controlled [...] hand, foot or solenoid operated air con[...] valve; tabular drawings with tables inclu[...] **Hannifin Corp.**, 1120 So. Kilbourn Ave., Chi[...]cago 24. L[...]

Measuring Machine

Special features of standard measuring machine presented in detail in illustrated ci[...]cular; elaboration on scales and how to [...] them, and specification table and drawing [...]cluded. **Pratt & Whitney, Div. Niles Bement Pond Co.**, West Hartford 1, Conn. L[...]

Clutch and Brake

Folder 213 shows "tornadyne" clutch [...] brake unit designed to cut press opera[...] costs, stressing advantages and special fe[...]tures; large cross section drawing in [...] shows parts and operation. **Clearing Ma[...] Corp.**, 6499 W. 65th St., Chicago 38. L[...]

Screws

Illustrated 28-page "Sems" catalog describ[...] line of lock washer screws is designed to as[...] plant personnel ordering and specifying ind[...]trial fasteners and holding devices; price li[...] and information to aid in meeting special ne[...] added. **Pheoll Mfg. Co.**, 5700 Roosevelt Rd., Chicago 50. L[...]

Metal Patterns

"How To Put a Crimp in High-Cost Produc[...]tion" features variety of "crimp" metal pa[...]terns: samples of diagonal, square, diam[...] and horizontal patterns shows wide applicat[...] and advantage of this line. **Nickeloid C[...]**, Peru, Ill. L[...]

Steels

Sixteen-page booklet serves as data sou[...] and selection guide on metal specifications a[...] chemical and physical properties of series [...] carbon and alloy steels for castings to fill re[...]quirements of standard commercial specifica[...]tions. **Dodge Steel Co.**, Tacony, Philadelphia 35. L[...]

Welding

Advantages of flash butt welding by co[...]trolled techniques and typical product applica[...]tions described in fully illustrated [...] booklet; features copper, aluminum, carb[...] steel, super-strength alloys. **The Americ[...] Welding & Mfg. Co.**, Warren, Ohio. L[...]

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Coolant Pumps

A full line of centrifugal coolant pumps, all conforming to J.I.C. standards to permit the use of any NEMA motor, will be shown at the ASTE Show by Pioneer Pump and Manufacturing Company, booth No. 532. The photo shows this Pioneer method of mounting any standard motor by use of a flexible coupling and a motormounting bracket.

This assembly at left is a submersible type designed for edge, side or top installation inside the coolant tank and normally rests directly on the bottom of the tank or reservoir. The assembly at center is built to mount on the side of a coolant tank or machine pedestal for close-coupled installation. No auxiliary inlet piping is required. The assembly at right is built for various types of connections to the driving unit and may be operated in a horizontal position, as shown, or vertically if desired.

T-4-145

Machine Tools

The Sheldon Machine Co., Inc., will display their latest developments in precision machine tools, such as lathes, millers and shapers. Booth No. 430.

T-4-145A

Tool Grinding Fixtures

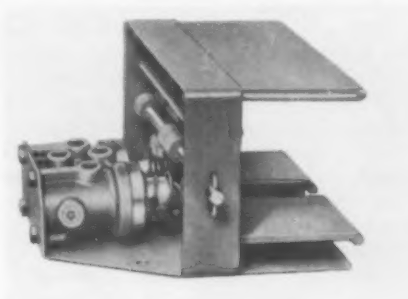
DS Grinder Division, Royal Oak Tool & Machine Co., will exhibit the Royal Oak fixture for grinding chip breakers—illustrated—on solid carbide inserts used with ejector-type tools.

Also, by Royal Oak, will be the DS Radial Relief Grinder. The latter tool will be displayed both as a hand-operated fixture and as a motorized unit. Booth No. 517.

T-4-108

Educational Exhibit

A series of small, efficient pilot valves, for direct control of small cylinders, or



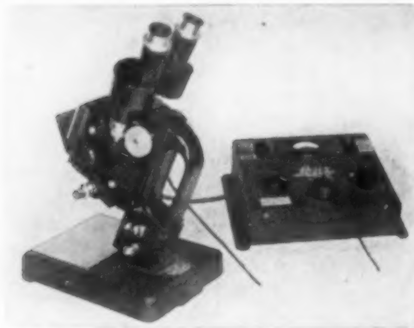
automatic control of large cylinders, will be exhibited by Hanna Engineering Works. Pilot valves shown will be cam, lever, push button or foot operated types, all 3-way except the foot operated valves, which are 4-way.

In the main, Hanna will have an educational exhibit centered around hydraulic and pneumatic cylinders and valves. It will consist of a series of scale models of cylinders as applied to various types of fundamental power movements, on the whole a demonstration of the unlimited ways in which fluid power can be applied to reducing production costs. Booth No. 772.

T-4-135

Comparators by Scherr

George Scherr Company, Inc., will have on display a line of precision instruments, among which will be featured Leitz comparators and microscope. Of these instruments, the Leitz comparison microscope illustrated may be considered typical.



This scope is an instrument for shop use for comparing surface finish against masters that have been accepted as standards throughout the metal working industry. Because of the stereoscopic feature, the two images are 3-dimensional and may be compared against each other without a discernible dividing line.

Other instruments to be exhibited by Scherr will include a counting and projection Microscope, an optical Comparator Gage, and the Toolmaker's Microscope with intermediate image. The latter instrument will be the main feature of the Scherr exhibit, space No. 209.

T-4-85

Indicate A-4-132-1

Hard-Metal Drill Kit

Firth Sterling Steel & Carbide Corporation announces the development of a Firthite drill especially designed for the drilling of metals up to 66 Rockwell C hardness.

For example, the drill is said to penetrate materials of a hardness equal to that of high speed steel tool kits, hardened steel files, or the softer grades of carbide. Ground from solid sintered carbide cylinders, they are pointed and relieved for free cutting and to produce an excellent finish without discoloring or drawing the temper of the material being drilled. To be featured among other Firthite tools in booth No. 1024.

T-4-178

Quick-Change Tools

Beaver Tool & Engineering Corporation will display, in Space No. 433, rigid, accurate quick-change Tool Holders for milling and boring machines of all types. These holders make it possible to change tools rapidly and accurately with practically no loss in time for the operation. Also displayed will be other cost cutting tools, such as solid carbide inserted-blade milling cutters, a complete line of milling machine arbors, adaptors and other boring and milling machine accessories. T-4-178A

Instruments by Engis

Among the several interesting tools by Engis Equipment Co., Booth No. 8[illegible] will be the several models of Clinometers or precision angle gages, illustrated. Also shown will be optical dividing heads, an optical projection type rotary table, industrial and tool makers microscopes, precision scales and gages and Hypriz Diamond Compounds and accessories. T-4-

Contour Projector by Kodak

A contour projector designed to provide greater working space for efficient staging will be demonstrated for the first time by Eastman Kodak Company, booth No. 816. Known as the Kodak Contour Projector, Model 2, this optical comparator provides a full 14¾ inches of work space between the lamphouse and lens, regardless of magnification.

In addition, the work table model has been enlarged to 20 inches in length and vertical travel has been increased from 2 to 4 inches. This advanced inspection tool will be thoroughly demonstrated, taking in various phases of application and adaption and a wide range of precision inspection requirements. **T-4-197**

Automatic Air Feeds

Automatic air feeds for punch presses, drill presses, and spot welders will be exhibited by Great Western Tools, Inc., booth No. 765. **T-4-197A**

Black Drill Units

Black Drill Units may be used in semi-automatic setups, as illustrated, for drilling several holes simultaneously. The units cycle automatically in unison from common push button station.

The units are air-operated, with self-contained hydraulic feed control and patented traversing motor rotor. All adjustment for feed, stroke, rapid advance depth control are made with three adjusting screws—no spline, cams, gears or clutch. Shown in space No. 724.
T-4-41

Wet Surface Grinding

Shown by Crystal Lake Grinders, booth No. 740, will be the C. L. Wet Surface Grinder, primarily designed for grinding of steel as well as cemented carbide dies and gage blocks, sapphire, and form grinding. The 15 in. height, which is a feature of these machines, takes work which heretofore had to be ground on planer type grinders.

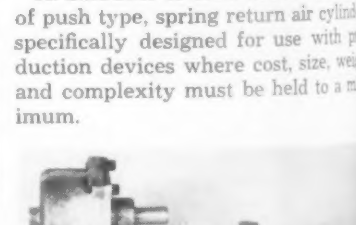
Heavily constructed for grinding of such materials as Sapphire and Norbide, the machine incorporates double taper spindle bearings selected for roundness between 0.000005 to 0.00001 in. The lead screw is 1⅝ in. in diameter and the cross feed screw is 1⅛ in. in diameter, with nuts for both 4 in. long. Other components are of equal ruggedness to provide the ultimate in precision grinding. T-4-17

Steam Cleaning

Industrial steam cleaning equipment will be exhibited by Livingstone Engineering Company, booth No. 11.
T-4-17A

Air Clamps by Schrader

A. Schrader & Sons will feature a line of push type, spring return air cylinders specifically designed for use with production devices where cost, size, weight and complexity must be held to a minimum.



All twelve models are compact in relation to strength, power and stroke, and have all working parts enclosed. Applicable to jigs, fixtures and other work holding devices or tools requiring small rugged cylinders for their operation. Booth No. 752. T-4-17

Universal Cylinder

A novel idea in cylinder design will be introduced by the Ortman-Miller Machine Co., Inc., booth No. 110. These cylinders, operated with air, water, or hydraulic power, feature simplified construction permitting longer wear with less maintenance.

Tie-rodless construction permits compact design and allows cylinders to be installed in a minimum of space; for example, the O. M. unit with a 6-in. bore cylinder is said to occupy no more space than a 4 in. bore unit of conventional design. Operation of the O.M. unit is guaranteed by the manufacturer to 1,500 cycles per minute continuous duty.
T-4-198

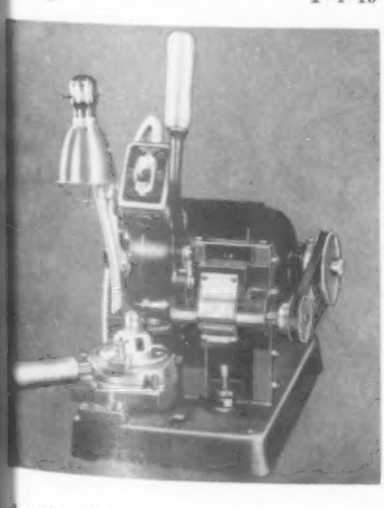
Automatic Bar Feed

Lipe-Rollway Corporation will exhibit the Lipe fully automatic magazine loading Bar Feed, for automatic screw machines and other bar stock machines. This self-contained unit operates entirely on air, the mechanism is simple and the unit can be quickly changed over for stock of different diameter and length. An "engineered" auxiliary to screw machining and turret lathes, its cost-cutting features are well within the theme of the ASTE show. Space No. 115.
T-4-198A

Sliding Fixture Setups

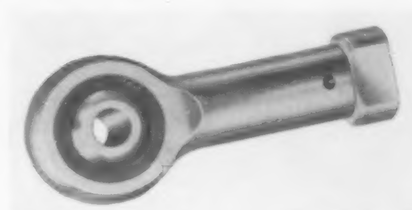
Exhibited in booth No. 204, by H. B. Rouse & Co., will be novel fixture setups in combination with the Rouse Hand Miller. This light yet rugged machine tool, which is reminiscent of a Lincoln miller in design principle, is widely used for fast production of precision aircraft, ordinance and instrument parts.

The scope of this versatile, low-cost machine is greatly broadened with sliding and rotary fixtures, of Rouse manufacture, which permit such operation as rapid circular, spline and bayonet lock milling.
T-4-19



Rod End Bearings

The Heim Company will exhibit the Heim Unibal spherical Rod End Bearings, designed for application on push-pull controls and linkages where it is



necessary to correct for misalignment. These rod end bearings, which will be shown in booth No. 559, are available with external and internal threads, right and left-hand. A spherical bearing is also available.

Typical applications are on connecting rods of roll feed mechanisms, speed change linkages or high-speed polishing lathes, connecting arm on air cylinders, bell crank and Pitman arm drives. Compactness of design and their high load capacity are said to make these bearings an ideal cost saving item for replacing more expensive and complicated parts.
T-4-27

Indicate A-4-135-1

High-Speed Jig Grinder

Among tools shown by Hau Machine Tool Corp., will be the fir series of the Hauser 3-S high-speed Ji Grinder. This Swiss precision jig grinder is said to combine the highest accuracy with exceptional output ca pacity. Incorporating the latest in engi neering design, the tool is protected throughout against grinding dust and grit, thus promising years of hard us without readjustment to ways and slide

With slide locations stated as ac curate to 0.00015 in., and accuracy of readings 0.0001 in., the machine wi grind to 5 in. maximum diameter; tape grinding up to 3 deg. Table working surface is 22x12¾ in., with longitudin and transverse travel of table slide respectively 16 and 10 in. Vertical trav of grinding spindle is $3\frac{5}{16}$ in. Spa No. 838. T-4-

Sine Fixture Key

As the "Tools of Today" eliminate th problems of tomorrow, so the Sine Fix ture Key by Jergens Tool Specialty Company eliminates the shaping o milling of key slots in fixture bases.

All keys up to and including 13/ in. are all on a ⅝ in. diameter shan making them interchangeable on an machine table. Demonstrations wi show how these keys cut costs in th making of fixture and in jig borin Booth No. 112. T-4-5

"Wearhide" Jig Bushings

Accurate Bushing Company, boo No. 142, will exhibit "Wearhide" dri jig bushings in the standard ASA sizes. Designed for severe drilling ap plications, these bushings have a wea resistant coating, in the hole, consisti of tungsten carbide particles held in metallic matrix fused to the tool st jacket. T-4-

Diamond Powders

Lapping compounds and diam powders will be displayed by A Abrasive Laboratories, booth No. 11

T-4-25C

Look at these COST-CUTTING FEATURES of the New NORTON Type CTU Cylindrical Grinders

1. Close-Approach Rear Base Design
2. Stand-Up Electrical Controls Mounting
3. Swing-Back Wheel Guard Cover
4. Mist-Control Hinged Hood
5. Easy-Swing Nozzle Mount
6. The Famous NORTON Wheel Spindle Unit
7. Space-Saver Ribbon Type Base Way Guards
8. Quick-Clean Coolant Ramp
9. Feather-Touch Work Jogging Lever
10. Finger-Tip Automatic or Manual Work Rotation Selector
11. Silky-Sure Hand Table Traverse
12. Quick-Action Pre-Set Truing and Grinding Speed Control
13. Either-End Table Dwell Control
14. No-Search "Click-Count" Wheel Feed Mechanism
15. "One-Lever" Grinding Cycle Control for Semi-automatics
16. Instant-Action Automatic Feed Rate Controls
17. Knee-High Hydraulic and Lubricating Pump Mounting

Compare Them With Your Present Equipment

Here are 17 of the reasons why you'll like the new Norton line of 6" and 10" cylindrical grinders—17 features that give new ease of operation and new ease of maintenance.

Compare these features with your present equipment. You will see how new efficiencies can be achieved with Norton CTU's that will give you the lower grinding costs so essential today.

New Features—New Catalogs

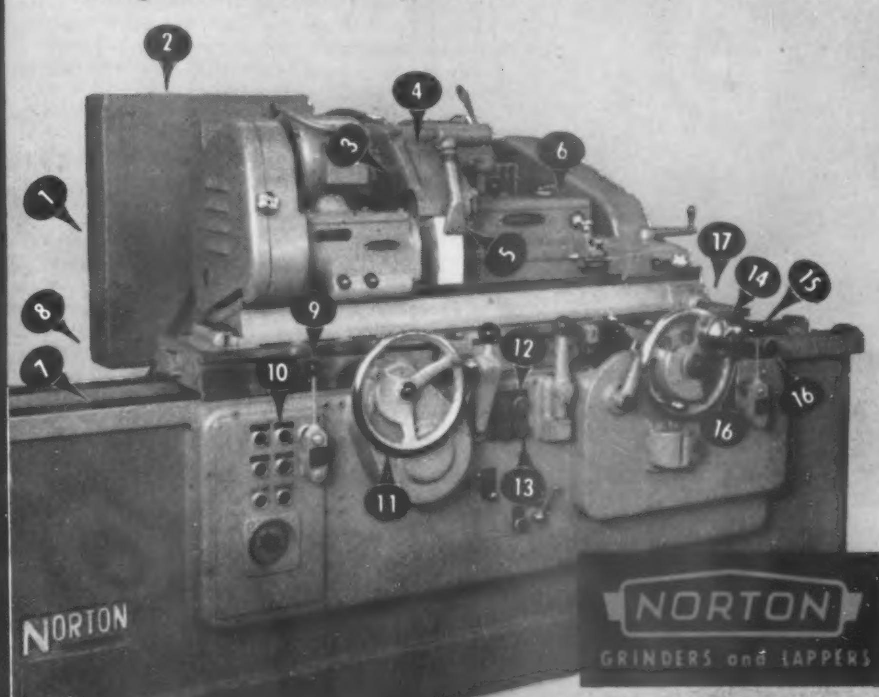
The outstanding features of these new Norton Grinders are graphically illustrated and described in a new series of catalogs. Write for any or all—no obligation.

Catalog 157-2—Norton 6" Type CTU Cylindrical Grinders.

Catalog 1488-1—Norton 6" Type CTU Semiautomatic Cylindrical Grinders.

Catalog 166-2—Norton 10" Type CTU Cylindrical Grinders.

Catalog 1787-1—Norton 10" Type CTU Semiautomatic Cylindrical Grinders.



NORTON GRINDERS and LAPPERS

NORTON COMPANY, WORCESTER 6, MASS. • New York • Chicago • Cleveland • Hartford • Distributors in All Principal Cities

Indicate A-4-137-1

Gages by Taft-Peirce

The Taft-Peirce Mfg. Co. will feature, in booth No. 325, the lately developed

Taft-Peirce Comp-AIR-ator Air Gaging Equipment and the Taft-Peirce Power Thread Gaging Unit. These two products are designed for faster and more effective inspection with minimum operator fatigue in quality control. Standard single dial and duplex dial comp-AIR-ators, and several specially adapted units will be on display.

A prominent place will be given to a group display of intricate products and parts produced on special order by the Taft-Peirce Contract Service Division, the extensive facilities of which will be illustrated in a series of plant photographs. T-4-122

Pocket Comparator

National Tool Company will pictur its Pocket Comparator, space No. 7 at the ASTE Show. This is a high-pre cision optical measuring instrument fo the inspection of small parts or sma dimension of large parts.

While small in size, it is calibrated measure lengths, widths, complete ci cles, radii and angles, and is equally ap plicable to tool room use and productio checking. T-4-

See also T-3-28

Decimal Size Reamers

Twentieth Century Mfg. Co. w show its "Supeream" line of reame in decimal sizes. This implies some individual sizes, carried in stock variation of 0.001 in. from 0.032, 0.0 0.034 in. and so on up.

Also shown by this company will "Uneeda" light, which directs a bea of white light just where needed f close precision work. Booth No. 5 T-4-75A

"Engineered" Lubricants

Tide Water Associated Oil Compan will be exhibiting a complete line lubricants "Engineered" to insure e cutting in the tool industry. Cutti and grinding oils of proven perfor ance will be exhibited at the Tidewa booth in an effort to provide t knowledge of their use to members the industry. Space No. 757. T-4-

Clamps and Lenses

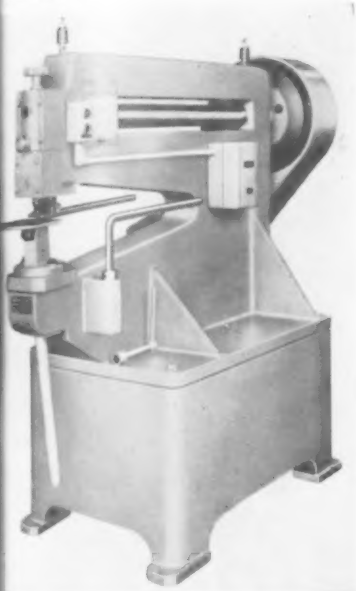
Montgomery & Company, booth N 1053, will exhibit the English-made "U tra Lens", also, the English-made Ha ber clamp, the latter a novel clamp device having a infinite adjustme within its range.

The Ultra Lens is designed for exa ination of fractures in metals, flaws cutting and other tools and for inspe tion in general. No time need be l in focusing. The instrument is pla on the part to be examined, the sw is snapped on and the user gets a po erful magnification in a brillia lighted field. T-4-

Indicate A-4-138-1

Nibbling and Cut-off

The Campbell Machine Division will have in operation the latest and improved types of wet and dry abrasive Cut-Off Machines. These models, all developed since the war, provide faster and more economical cutting with closer tolerances.



Redesigned nibbling machines will also be exhibited. Two speeds with V-belt drive permit cutting thinnest material to full capacity of machine with longest punch life. Variable stroke feature also increases punch life and allows use of thin templets, regardless of work thickness. Booth No. 226.

T-4-176

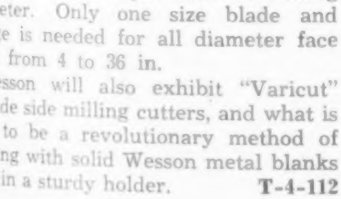
Fabricated Products

Fabricated products will be exhibited by the Heintz Mfg. Co., booth No. 1002. Included among cabinets, jet engine parts, barrels miscellaneous products will be an automatic dishwasher and a fan mount. T-4-176A

"Rigidcut" Face Mills

Wesson Company, booth No. 1013, will feature "Rigidcut" fine tooth face milling cutters among a broad line of Wesson tools. These mills have been engineered especially for milling speeds up to 90 in. per minute; and the unique construction permits the use of a great number of blades per inch of cutting diameter. Only one size blade and wedge is needed for all diameter face mills from 4 to 36 in.

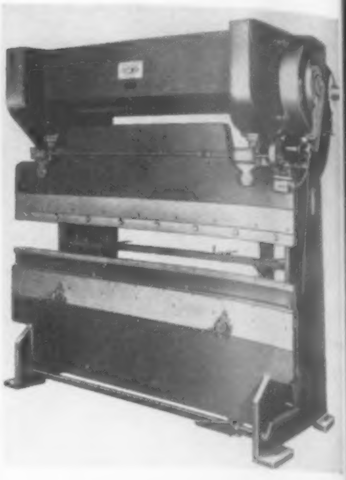
Wesson will also exhibit "Varicut" carbide side milling cutters, and what is said to be a revolutionary method of forming with solid Wesson metal blanks held in a sturdy holder. T-4-112



For further information, use Reader Service Card. See pages 129-130.

Power Press Brake

Edward A. Lynch Machinery Company will exhibit the Chicago steel power press brake, shown, for forming, bending and notching of steel, stainless and aluminum sheet metals and plates. These press brakes are available in capacities from 11 to 450 tons.



Also shown will be the Liebert Hi-Speed shear for shearing irregular shapes; the Webb initial pinch-type Plate Bending Roll for rolling plates and sheets into cylinders; the Webb "Steel-worker" combination shear, punch and coper, and the Quick-work-Whiting stamping trimmer, for trimming flash in a single plane as well as for handling beading and forming operations in the same or separate passes. Space No. 1072.

T-4-162

Induction Heating

Featured by Tocco Division, the Ohio Crankshaft Company, will be induction heating equipment. Also shown will be electrical controls and generators. Booth No. 205. **T-4-162A**

Adjustable Boring Tools

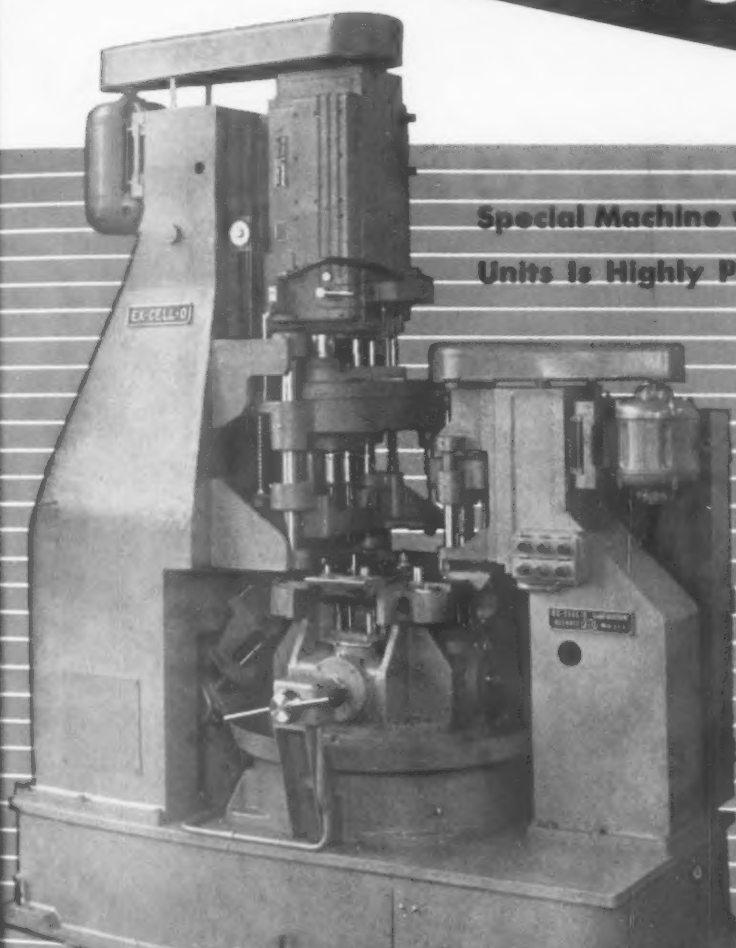
C. C. Craley Mfg. Company, booth No. 1149, will exhibit an interesting line of precision adjustable Boring Heads and single-point boring tools. Easy to operate, and sturdily constructed for long life, these tools have micrometer adjustment which adapts them to jig boring.

T-4-105

WANT TO

CUT COSTS?

See EX-CELL-O



Special Machine with Ex-Cell-O "Package" Power Units Is Highly Productive . . . Low in First Cost!

Ex-Cell-O machines for combined operations save floor space, save handling, save man-hours. When Ex-Cell-O's standard hydraulic power units are used for feeding and rotating the cutting tools, the first cost is low. The Ex-Cell-O special machine shown to the left drills nine holes, reams one hole, and taps three holes in cast iron water pump body at a net rate of two parts per minute! If your production involves operations like this, get in touch with Ex-Cell-O in Detroit today!

EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

Special Multiple Way-Type Precision Boring Machines • Special Multiple Precision Drilling Machines • Precision Boring, Turning, and Facing Machines and Fixtures • Precision Cylinder Boring Machines • Precision Thread Grinding Machines • Precision Lapping Machines • Precision Broach Sharpening Machines • Other Special Purpose Machines • Tool Grinders • Continental Cutting Tools • Broaches and Broach Fixtures • Counterbore Sets • Grinding Spindles Hydraulic Power Units • Drill Jig Bushings • R.R. Pins and Bushings • Fuel Injection Equipment • Dairy Equipment • Aircraft and Miscellaneous Production Parts

Indicate A-4-141-1

For further information, use Reader Service Card. See pages 129-130.

Perforating Equipment

Wales-Strippit Corporation, space No. 908, will have in operation the Wales Sheet Metal Fabricator, the Wales Perforating Method for television, radio and electronic instrument panels operating in a Bliss press, and a complete line of Wales self-contained piercing and notching equipment. T-4-64

Cutting Tools by O.K.

O. K. Tool Co., Division of Williams & Hussey Machine Co., will exhibit a line of miller, planer, and shaper cutting tools; also, tool holders and tool room accessories. Booth No. 221 T-4-64A

Di Acro Benders

O'Neil Irwin Mfg. Co., space No. 316, will feature among its improved line of Di-Acro tools their lately developed Hydra-Power Bender. This tool is a trouble-free hydraulic power unit designed to perform not only a few specialized operations, but any of the many bending jobs which might arise in a metal-working plant.

Functional in design yet superbly engineered, this machine is built for universal application in that it can be readily converted to a "custom-built" unit to fit each forming requirement. T-4-124

Press Feeding Device

The Feed-O-Matic, by the V & O Press Company, is a punch press feeding device for secondary die operations that transfers parts from a nesting plate to standard punch press die by means of mechanical hand or vacuum pick-up. As the mechanical hand returns for the next part it automatically trips the press and the finished part is ejected from the die. Shown in booth No. 764.
T-4-111

Multi-Spindle Drills

Seibert & Sons, Inc., will exhibit parts and components for multiple spindle drills. These will include pinion shafts, upper and lower drive assemblies, slip spindles and universal points for diverse applications. Booth No. 1052. T-4-111A

Modern Machine Shop

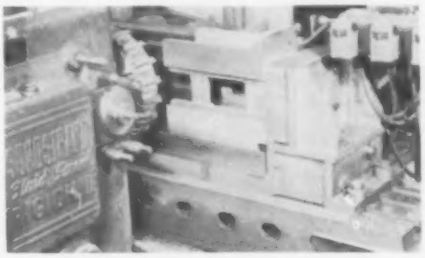
A Gardner publication, Modern Machine Shop contains a lot of industrial "know-how" in a pocket size package. Booth No. 1111. T-4-111B

Static Balancers

The "Hi-Eff" universal static balancing machine, by the Taylor Dynamometer & Machine Co., will be shown solving "out-of-balance" problems. This equipment enables work to proceed at production-line speed, while maintaining the close tolerances which are often essential to production performance. Booth No. 653. T-4-204

Tools by Sundstrand

Three divisions of the Sundstrand Machine Tool Company will exhibit products in Booth No. 907. Among these, the Sundstrand Magnetic Products Division will exhibit Power-Grip magnetic chucks, with a display of cost-



cutting magnetic work-holding fixtures such as the one shown set up for a heavy milling operation.

Also, by this Division, will be introduced the Sundstrand Magnetic Coolant Separator, a basic unit which may be installed on all types of grinders without alteration to original equipment.

The Pneumatic Division will show single and double pad portable sanders for sanding, rubbing or polishing on metal, wood and plastics; also shown will be balancing tools and bench centers. The Hydraulic Division will exhibit a line of pumps, valves, fluid motors and tank units which conform to J.I.C. standards. T-4-42

For further information, use Reader Service Card. See pages 129-130.

Machine Tool Auxiliary

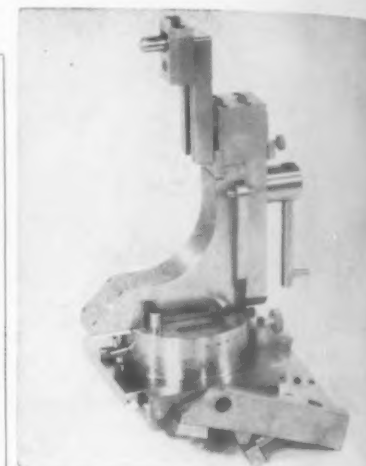
The Versa-Mil, by the Versa-Mil Company, is a power-driven machine tool auxiliary designed to add precision milling, drilling, boring and grinding to such machines tools as engine and turret lathes, planers, boring mills and even milling machines.

An advantage of the unit, which is self contained, is that it will perform heavy work as well as a series of different machining operations with the work remaining in place in the one setup. It can also be used as a portable machining unit, independent of other machine tools, on heavy production equipment or for maintenance work.

Engineered to rigid machine tool standards, the Versa-Mil is said to maintain the precision tolerances of the machine tool with which it may be combined. Booth No. 330. T-4-

"Fluidmotion" Dresser

Fluidmotion Wheel Dressers, by J. S. Tool Co., Inc., generate wheel profiles in such a way that angles and radii flow into each other, without sharp changes of direction. The result is a clean, precise form entirely free of the chatter marks or tool marks caused by tension and machine vibration when interruptions occur. Fluidmotion wheel dressing produces a perfect blend of angles and radii.



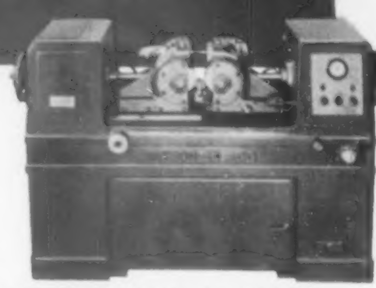
Only one setting is necessary for dressing two angles and a radius, using one handle in one continuous motion. The diamond returns to center position automatically after dressing angles. Precise, sharp contours are said to be obtainable consistently within 0.0001 in. accuracy. Space No. 954. T-4-

Band Saw

A low-cost portable Kalamazoo metal-cutting band saw machine—Model 610S, space No. 1012—cuts tubes, bars, angle, pipe with ease and accuracy up to a capacity of 6x10 in. Features are four cutting speeds from 53 to 266 fpm, constant blade pressure, blade mounting from the top and double set of opposed cleaning brushes. Equipped with a 1/3 hp 110/60/1 standard mounting motor. Weighs but 200 lbs., and can be equipped with casters for complete portability. Manufactured by Machine Tool Division, Kalamazoo Tank & Silo Co. T-4-

ROLL CLASS 4 THREADS

SERRATE, KNURL AND BURNISH— AT MASS PRODUCTION SPEEDS



Through-Roll Any Length Over 2¼"

WATSON-FLAGG
MODEL "C"
PRECISION THREAD ROLLER

A VERSATILE MACHINE FOR THE WIDEST RANGE OF WORK

Extra-heavy frame gives rigidity to handle high hydraulic rolling pressures.

Open, accessible work area allows for a greater range of sizes and shapes.

Low die costs and simple set-up make runs as small as 1000 pay off.

Extreme flexibility of operation is assured by the available pressures and spindle speeds, permitting adjustments to accommodate wide variation in the four critical work factors: Hardness—Pitch—Diameter—Length of Thread.

PROFITABLE! On runs as small as 1000!

HERE'S WHY: Only two large rolling dies are used. Synchronization is quick and easy. Set-up time is measured in minutes.

Uniformity is automatically controlled — only spot checking is necessary—no operator skill required.

Send details on any thread or form rolling operation to Watson-Flagg, 826 E. 25th St., Paterson, New Jersey. Our engineering staff will tell you what to expect from the Model "C".

At Booth No. 1142, A.S.T.E. Exposition, April 10-14

WATSON-FLAGG MACHINE COMPANY, Inc.

SPEED REDUCERS • GEARS • SPECIAL MACHINERY

PATERSON, NEW JERSEY

Indicate A-4-145-1

For further information, use Reader Service Card. See pages 129-130.

Precision Thread Roller

Watson-Flagg Machine Co., Inc., will exhibit its line of Precision Thread Rollers in the form of a heavy-duty model with increased work capacities. The ability to roll continuous thread, knurls or serrations is one of the features of this Heavy-Duty Model "C", here shown in close-up rolling threads on a long rod.

The machine will now take diameters from 0.138 up to 4 in. with a maximum of 8 pitch. Its regular length of thread capacity, when through-rolling is not being used, is 2¼ in. standard, 3¼ in. maximum. It will handle any material that has an appreciable percentage of elongation.

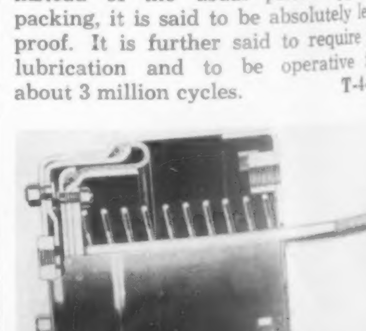
Threads, knurls or serrations are formed as the blank is rotated between two cylindrical dies of 6½ in. average diameter. These large dies provide high surface rolling speeds of 200 to 540 fpm and an average of 20.4 in. of useful circumference factors that combine to provide maximum output and die life. In space No. 1142. T-4-52

Modulator Mounts

Vibro Modulator Mounts will demonstrate their modulator mounts in booth No. 748. Plant engineers who have problems of noise and vibration should investigate the merits of these mounts which isolate vibration and reduce noise. T-4-52A

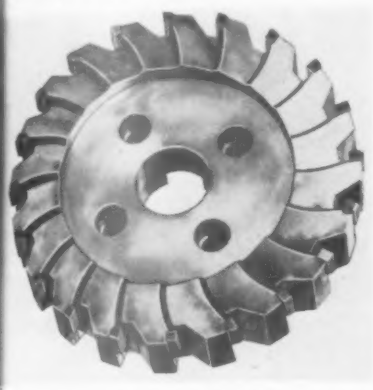
Novel Air Chamber

Shown among the exhibits of Bendix-Westinghouse Automotive Air Brake Co., space No. 333, will be a novel type of Air Chamber. Similar to an air cylinder and incorporating a diaphragm instead of the usual piston type of packing, it is said to be absolutely leak proof. It is further said to require no lubrication and to be operative for about 3 million cycles. T-4-10



Fine Tooth Face Mill

A fine tooth face mill, especially de-[s]igned for milling cast iron rims and [b]osses, will be exhibited by Nelco Tool [C]ompany, Inc. Doubling the number of [t]eeth normally used in the conventional [fa]ce mill, design allows for extra tooth [e]ngagement and makes a smoother run-[ni]ng cutter. The solid "brazed-on" type [w]ith alloy steel bodies, extra heavy car-[bi]de tips—sandwich brazed with nickel [s]him—makes an excellent tool where [r]igidity and long cutter life is requisite. [A]vailable in 6, 8, 12 and 14 inch diam-[e]ters. Space No. 561. **T-4-190**



The Marshall Plan

The United States Department of [C]ommerce will exhibit Commerce pub-[l]ications which should be of interest [t]o the tool trade, both in their domestic [p]rograms and in the foreign trade field. [P]ersonnel in attendance will explain [t]he Department's services to business-men, including the many aids which are [a]vailable to the foreign trader. Selling [u]nder the Marshall Plan will be one of [t]he subjects on which information will [b]e available. Booth No. 39. **T-4-190A**

Tool Steel Products

Edgecomb Steel Company, booth No. [6]18, will have an interesting display of [t]ool steel products. **T-4-190B**

Tools by Stellite

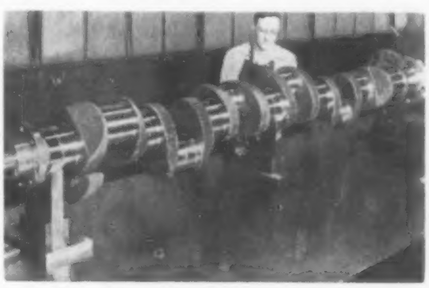
Haynes Stellite Division, Union Carbide and Carbon Corporation, will show a complete line of metal-cutting tools including square, rectangular and round tool kits, boring and reaming blades, tipped tools, tool tips, grooving tools, cut-off tools and insert milling cutter blades.

A variety of parts made by the Haynes precision casting process, showing the smooth finishes and intricate shapes that can be obtained from hard-to-machine alloys, will also be displayed.

In addition, "Haynes" alloys for resistance to wear, heat and corrosion will be shown in the form of conventional sand castings, hard-facing rods, and parts fabricated from sheets, plate and bar stock. A small display of "Metamic" metal ceramics in the as-produced condition, as well as parts that have been machined, will be included. Booth No. 509. **T-4-190C**

Cost-Cutting in Tapping

The Hybco Tap Grinder, by Henry P. Boggis & Company, is designed to provide proper facilities for complete tap sharpening, which in turn reduces production costs because of extended tap life and less scrap.



Indicatoins of the value of correct tap sharpening is the practically last-minute tapping of the end flange of the huge crankshafts illustrated, a product of Ohio Crankshaft Co. Boggis will demonstrate the Model 1100 Hybco Tap Grinder, in actual operation, in space No. 401. **T-4-72**

Automatic Screw Machines

Russel, Holbrook & Anderson, Inc., will exhibit the latest additions to the line of Petermann automatic screw machines. Typical of these machines, the P-16 has novel features such as the double rocker arm which permits the use of both rocker tools simultaneously, and also simultaneously with the four upper tools.

The machine, which has a bar capacity of 16 mm—or slightly over 5/8 in.—and spindle speed of 7200 rpm, follows the usual movements of Swiss automatics in that stock is fed through a carbide bushing and all cutting operations are within a few thousandths of the point of support.

Also to be exhibited will be the Agathon Carbide Grinding and Lapping machines, booth Nos. 608 and 614. **T-4-72A**

Face Mills by Gairing

The Gairing Tool Company—Booth No. 936—will exhibit its Series 6500 E-Con-O-Mill, available in 8, 10, 12, and 14 inch diameters, with 16, 20, 24, and 28 inserted carbide tipped cutter blades respectively. Apart from their far greater blade number, these new mills incorporate all the economy features claimed for the earlier E-Con-O-Mills, introduced two years ago.

Blades come finish ground and may be individually sharpened without removing the cutter from the machine. The same blades serve all sizes of series 6500 cutters. They are made to cut steel, cast iron, and non-ferrous materials, each type with the proper carbide and the correct radial and axial rakes for its purpose. Wedge type locks fit all E-Con-O-Mills, draw the blades tight against bottom and sides of the slots, and remain attached to the cutter body when blades are removed. T-4-46

Wheels to Cut Costs

The Allison Company, producer of rubber-bonded abrasive cutting wheels will feature their resinoid-bonded Cutting Wheel at the ASTE Show. Under development and field test for several years, this wheel is said to offer marked efficiency and economy in the dry cutting of metals, ceramics and other industrial materials.

These wheels will be demonstrated on a typical machine; also, there will also be machines demonstrating wet cutting of a large range of materials. Attending Allison exhibit will be sales service and field engineering personnel. Booth No. 206. T-4-46A

Outside Turning Tools

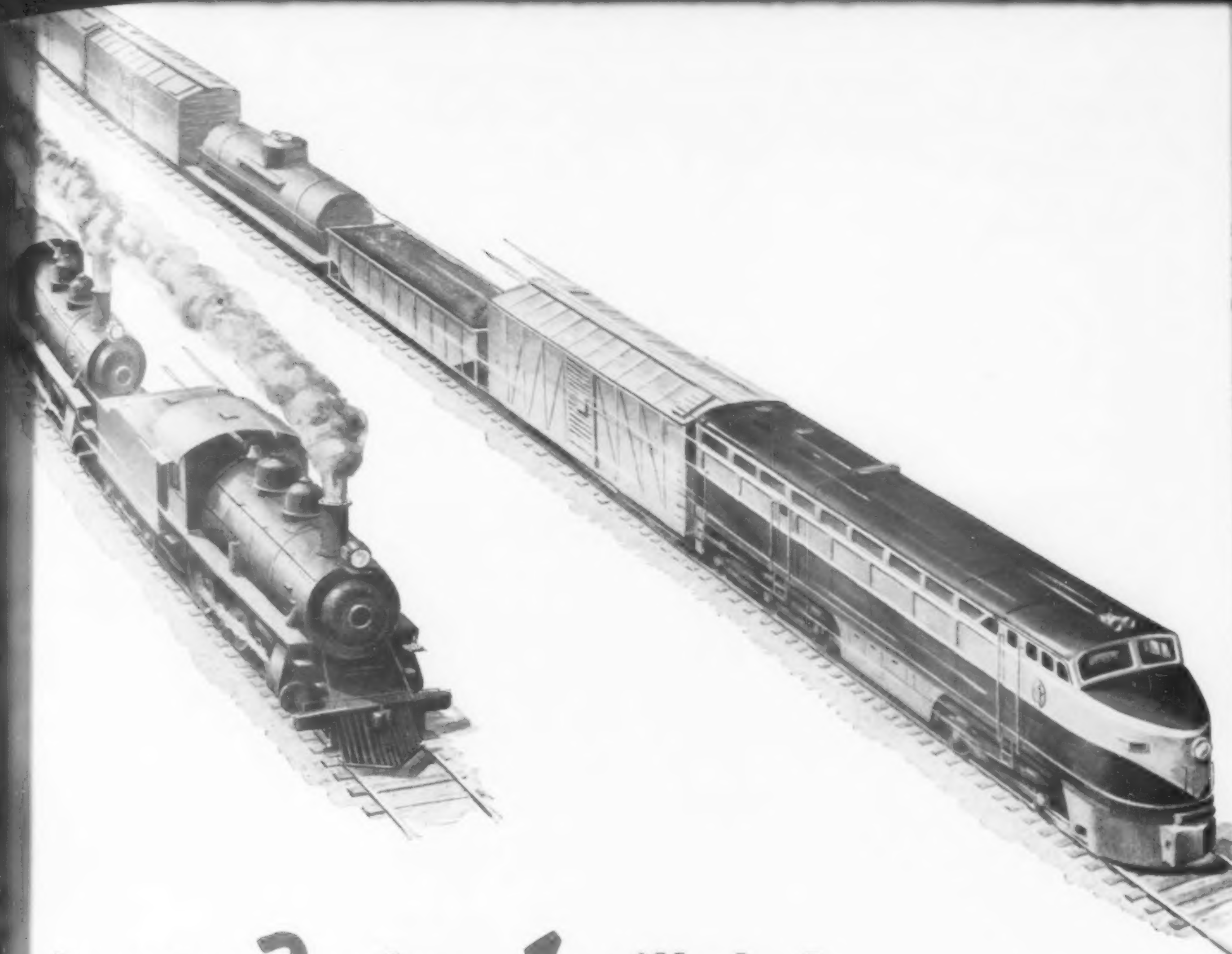
Shown for the first time at the ASTE Show, by Bokum Tool Company, will be a combination cutting blade and holder designed for lathes and turret lathes to bring greater economy and efficiency in roughing, finishing and external threading. Since this tool utilizes high speed steel only where it is actually needed—that is, at the cutting contact, not for the entire tool—the saving in tool cost is obvious.

There are five models, each having a distinctive form, with cutter set at a different angle. Carbide-tipped cutter blades are also available. Side and front clearances are provided and resharpening is done only on one face, as with the Bokum internal boring tools. Booth No. 1049. T-4-184

High Speed Stock Feed

A recently redesigned Stock Feed Accessory for the Denison Multipress will be featured in the display of the Denison Engineering Co., booth No. 1032. The feed now offers high speed feeding of roll stock to 3/64 in thickness and at speeds up to 838 per minute. At top speed, the unit is said to be capable of producing over 50,000 pieces per hour.

Other equipment being displayed for the first time includes high pressure pumping units, with variable control of volume to 35 gpm and at pressures to 5000 psi; a surge damping valve developed for aircraft usage and available soon for commercial purposes; constant and variable volume hydraulic pumps, pressure and directional controls, and fluid motors including a compact motor operating at 2500 psi at speeds to 3000 rpm. Among press equipment to be exhibited will be the one-ton Multipress Midget with dial feed, a 25-ton capacity Multipress with index table and a standard 8-ton manually controlled Multipress. T-4-184A



why use 2 when 1 will do?

one Heald 321 Bore-Matic now does the work of two older types of machines

Today, more than ever before, a machine is judged by its capacity to do work efficiently. And when a new Heald machine can take the place of two others, the latter are definitely "dated" — regardless of their year of manufacture.

All Heald machines — Bore-Matics, Internal Grinders, and Rotary Surface Grinders — are engineered to provide the extra margin of versatility, speed, accuracy and precision that can bring substantial savings to your fast-moving production line.

Remember — when it comes to precision finishing, it pays to come to Heald.

Rocker Arms produced twice as fast on a Heald Model 321 Bore-Matic — by combining operations to eliminate extra manufacturing steps. The parts are precision bored and chamfered, two at a time, in a special two-station fixture with rapid hand cam clamping. The complete cycle is fully automatic. All the operator has to do is load and unload the parts and press the start button.

THE HEALD MACHINE COMPANY

WORCESTER 6, MASSACHUSETTS

HEALD

Branch Offices in Chicago • Cleveland • Dayton • Detroit • Indianapolis • Lansing • New York

"Powerarm" Positioners

Powerarm positioning tools, by Wilton

Tool Mfg. Co., are designed to eliminate waste motions and to lower labor costs. Now available in two distinct models—mechanical and hydraulic — each of which has its own characteristics.

The mechanical unit is a quick-setting and fast-releasing mechanism designed for use on moving production lines and conveyor belt assembly lines. The hydraulic Powerarm is a slower setting mechanism, and features its slower, gradual ability for releasing work. This unit is best adapted to tool making and other hand operations where fine adjustment and delicate handling is a requisite. To be demonstrated in space No. 550. T-4-125

"Hallowell" Carry-Tool

Standard Pressed Steel Company will exhibit the sturdy, easy-rolling Carry-Tool, the latest addition to the company's Hallowell line of shop equipment.

This handy, time-saving tool carrier is made of heavy-gauge steel, with large drawers that slide easily on ball-bearing rollers. Padlock attachments protect contents, and exclusive design provides extra rigidity and tightness under heavy loads. Booth No. 128. T-4-1

Production Setup

The Walker-Turner Division, Kearney & Trecker Corp., exhibit will feature the adaptation of air feed to W-T drill presses and radial cut-off saws. Also shown will be a newly developed, electrically driven power feed for metal cutting band saws.

Two drill presses, one set up for automatic drilling operations and the other for tapping, will be in operation on production work during the show. The radial cut-off saw with automatic feed and work holding device will also be operated.

The band saw feeding device will be demonstrated on a newly developed in. metal cutting band saw. All the equipment will be shown to the public for the first time. Booth No. 105.

T-4-187A

Demonstration by Jarvis

The Charles L. Jarvis Company will display and demonstrate their latest products in booth No. 807. Included will be multiple tappers, precision machine ground tungsten carbide rotary files, solid carbide reamers and mills, knurls and boring bits.

In addition, there will be demonstrated the Jarvis line of flexible shaft machines, "Torqomatic" tapping attachments, "Tecni-taps" and ground-from-the-solid HSS and tungsten carbide rotary files. T-4-1

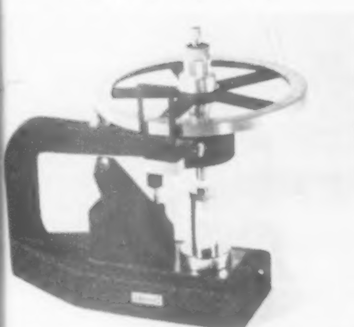
Deep Throat Press

A 25-ton Roussele deep throat press No. 3-G—has been added to the regular line of standard and special punch presses by the Service Machine Company. This press will be exhibited at the ASTE Show.

This press has an 18 in. throat which permits working to the center of 36 in. sheets, making it ideal for fabricating shops to increase their scope of press operations as well as save time and material by using wider sheets. The standard bolster plate measures 14 x 20 in. Space No. 619. **T-4-148**

Light Wave Micrometer

Featured by the Van Keuren Company will be the 0-3 in. Van Keuren Light Wave Micrometer, an ultra-precision bench measuring machine said to be capable of making direct measurements in units of 1/100,000 in.



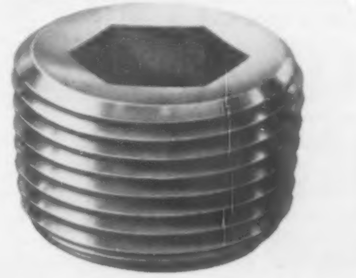
Its remarkable accuracy makes it an ideal inspection and checking tool for measurement of screw threads, taps, gears and splines, the standardization of plug gages as well as other measurement of soft materials, fine copper wire and other materials requiring ultra-accurate measurements. Booth No. 410. **T-4-78**

Quick-Change Coupler

Exhibiting in booth No. 642, Foster Manufacturing Company will display Duplate plastic hose, chrome sleeve hose and a quick-detachable coupler. Booth No. 642. **T-4-78A**

"Dry Seal" Pipe Plug

The Allen Mfg. Co. will feature two hex socket Pipe Plugs designed to eliminate important causes of sealing failures. The standard pipe plug is threaded strictly in accordance with



Army-Navy Aeronautical Specification AN-P-363. Because of its precise roundness and smoother threads, a sealing compound is not ordinarily required for pressure-tight joints.

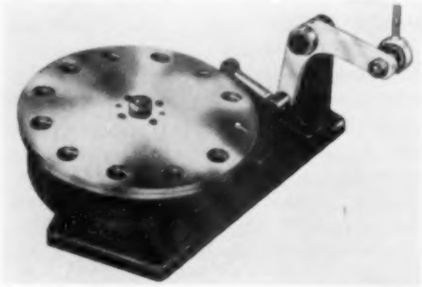
These pipe plugs are entirely pressure formed. Cold-drawn heads preclude weakening by drilling and broaching, and pressure forming makes a perfect hexagon socket which will break the strongest key before the socket strips.

These Allen "Dryseal" pipe plugs are designed for use with Dryseal taps, and applications include refrigeration, marine, automotive and aircraft fuel connections where a tight joint is absolutely essential to public safety. Space No. 524. **T-4-113**

Indicate A-4-151-1

Press Dial Index

"Speedex" dial index feeds will be featured in actual operation on punch presses, coining "money" for our customers. The Speedex, by O. F. de Castro & Associates, is a mechanical



operated, positive locking automatic indexing table, guaranteed by the maker to index within 0.0002 in. on a 12 in. circle. Also, for the first time, de Castro will show the late model Speedex 5-ton Dial Feed Press, a back geared press especially suited for assembly and second operation work.

A Speedex dial index feed, mounted on a drill press with the improved "Knapp-Speedex" Pre-Selectric power feeder for drill presses, will also be in operation. The Pre-Selectric is an automatic drill press feed that features automatic chip clearance, torque control, and automatic start and stop with only two basically moving parts. Booth No. 1058. T-4-185

Carbide-Inserted Bushings

Meyco carbide-inserted drill jig bushings will be featured by W. F. Meyers Company. These bushings are made to A.S.A. standards and are available in any of the commonly used sizes. Specials may be made to specifications. Tabulated catalog available. Space No. 22.
T-4-191

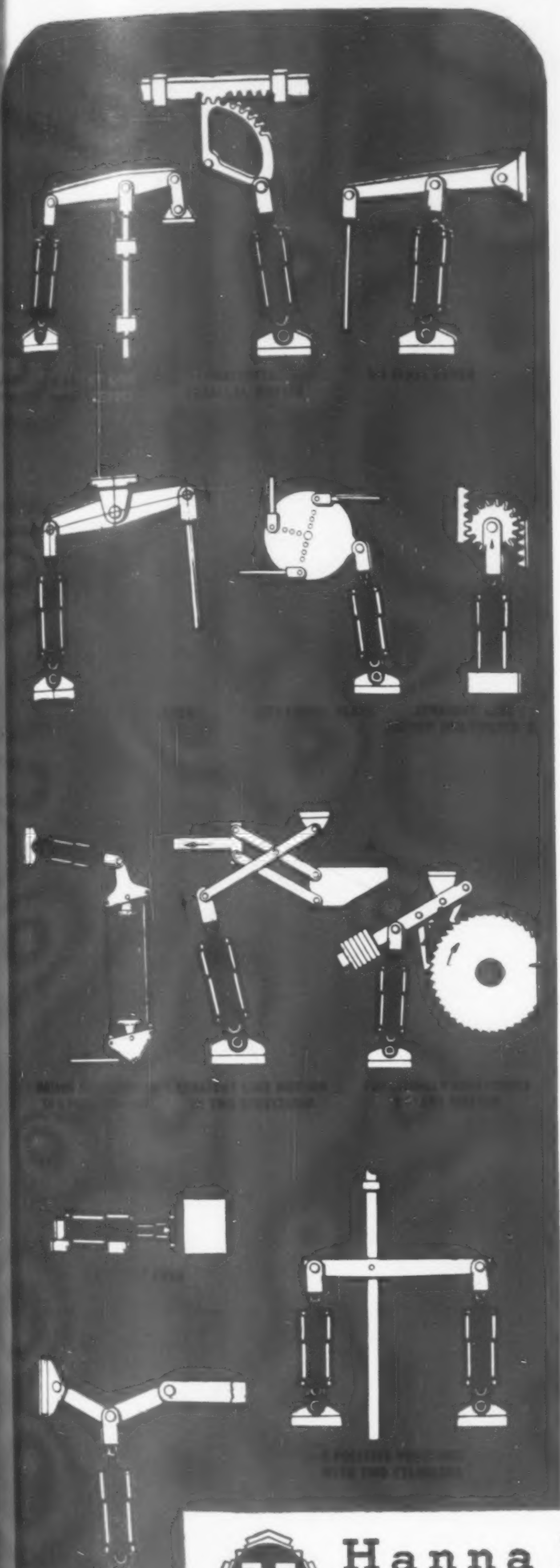
Manufacturing Analysis

Manufacturing Analysis is a 450-page book designed as an aid in the training of tool engineers. Essentially an analysis of manufacturing and presented so that students may progress through the course in progressive steps, it embraces methods of manufacture, the tools used and production costs. Compiled by Richard F. Kipers of Rochester Institute of Technology and sponsored by the American Society of Tool Engineers. Information at the ASTE booth, No. 888.
T-4-191-A

Dial Assembly Press

Precision Detroit Company will exhibit an interesting 6-station Dial Assembly Press, space No. 544. Delivering its energy through a powerful toggle action to the ram, this press has a range up to 6 tons for continuous assembly operations.

Dialing is by a positive Geneva action, and dials may be quickly interchanged so that various dials may be permanently tooled for different parts assemblies. Provision is made for hopper feed of part to be assembled.



There are 1001 Applications for Hanna Cylinder Power In Machine Tools and Equipment

The fundamental mechanical movements at the left suggest just a few of the many ways Hanna Cylinders may be put to work for you—to actuate and control machines and equipment simply, economically, dependably.

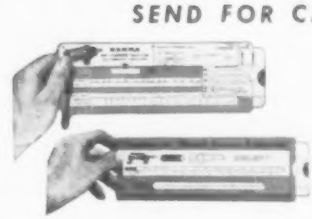
Smooth, efficient Cylinder Power can be profitably employed for practically every application where there is a push, pull, lift, press, clamp or control problem. Cylinder Power can speed up production, improve performance, reduce manual effort and save on costs.

There is a standard line of Hanna Hydraulic and Pneumatic Cylinders for nearly all mounting requirements. Get complete information and see how Cylinder Power can work for you.

See these Mechanical Movements
In Action at Hanna Booth 772

ASTE INDUSTRIAL EXPOSITION
CONVENTION HALL, PHILADELPHIA
APRIL 10-14

SEND FOR CALCULATORS



Two Cylinder Calculators are available. One is the Hanna Cylinder Selector and Pneumatic Calculator which gives facts and figures on pneumatic power; the other is the Hanna Calculator for Hydraulic Cylinders, which shows at a glance important hydraulic power information.

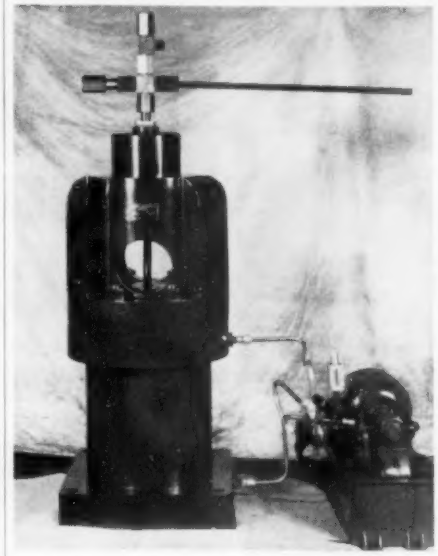
Hanna Engineering Works

1765 ELSTON AVE., CHICAGO 22, ILLINOIS

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES . . . RIVETERS

Indicate A-4-153-1

Hydraulic Intensifier



An hydraulically driven Intensifier to develop extremely high pressures up to 200,000 psi, will be exhibited by Rivett Lathe & Grinder, Inc., booth No. 1020. The low pressure side of this intensifier is composed of standard Rivett components including power unit, valving and a 14 in. cylinder rated for 1500 psi. The intensifier is a product of Harwood Engineering, associated with Rivett. A typical installation will be demonstrated at the ASTE Show using high pressure to measure the rupture point of tubing.
T-4-165

Jig and Fixture Design

A joint publication of the American Society of Tool Engineers and the New York State Vocational and Practical Arts Association, Jig and Fixture Design takes in the elements of design; tool design. Information at the ASTE booth, tion plans; and tool drawings. Three volumes replete with the know-how of design. Information at the ASTE booth, No. 888. **T-4-165A**

Ultrasonic Inspection

Sperry Products Company will exhibit the Reflectoscope and the Reflectogage, both designed for sub-surface inspection of materials. Also shown will be transformers and reactors, self-sealing couplings and hydraulic remote controls. Booth No. 13. **T-4-165B**

Precision Parallels

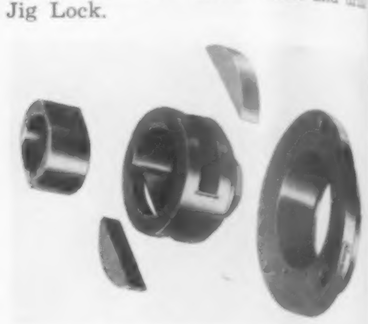
Anton Machine Works, booth No. 17, will have an exhibit of magnetic and non-magnetic parallels; also transmitting tube parts. **T-4-165-C**

Rolling Oils by Sunoco

Straight and emulsifying oils which permit maximum productions in rolling steel and non-ferrous sheets will be displayed by Sun Oil Company, booth No. 717. Also exhibited will be Sunicut transparent cutting oils, emulsifying cutting oil, and Sun quenching oils.
T-4-165D

Automatic Fixture Lock

The Siewek Tool Company, manufacturers of standard drill jigs, fixture clamps and details, will feature what is said to be a radically improved cam-type automatic Fixture Lock and drill Jig Lock.



This cam-type automatic lock is used on all standard Siewek rack and pinion type drill jigs and is available to manufacturers and designers of special holding devices and machinery as a fixture lock.

In construction it meets the demand for secure and accurate holding power, effectiveness at all points of travel and quick release. These requisites, plus simplicity of design and accurate construction are built into dependable operation and longer life. Space No. 2
T-4-120

Saws by Circular Tool

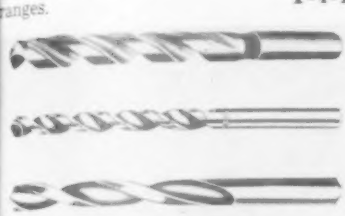
The entire line of Circle R Metal Cutting Saws, products of the Circular Tool Co., Inc., will be on display at the ASTE Show, booth No. 225.

Among the Circle R saws on display will be metal cutting, slitting and slotting saws and slitting disks; solid carbide and carbide tipped saws and others ranging from ¼ to 10 in. in highspeed steel. Circle R combined drills and counter sinks, as well as center reamers, will also be included. T-4-120A

Carbide Twist Drills

Shown by Super Tool Co., booth No. 315, will be Super Carbide Twist Drills in sizes and types suitable for the proper application of carbide to drilling.

Available in both carbide-tipped and solid carbide tips—the latter in sizes ¼ in dia. down to No. 53. The carbide-tipped drills range from 3/32 to 1 in. diameter, and the assortment provides drills for any job within their size ranges. **T-4-115**



Brazing Demonstration

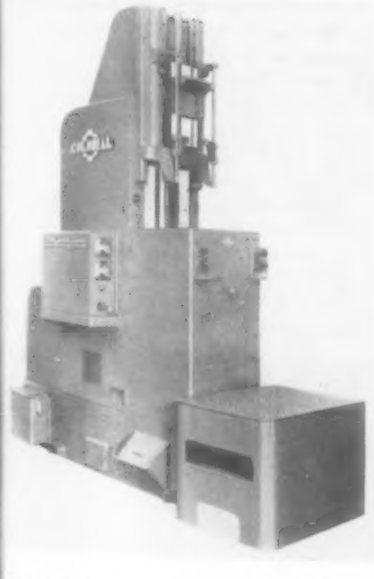
As a feature of its exhibit, space No. 607, Handy & Harman will demonstrate the joining of ferrous and non-ferrous metals with Silver Brazing Alloys, Easy-Flo and Sil-Fos.

Two brazing stations will be in constant operation, one featuring torch brazing and showing how these low-temperature alloys make strong, ductile joints by following simple procedures. The other will show how the use of a simple production setup makes it possible to get any desired production. An experienced engineer will be in constant attendance to discuss brazing problems with visiting tool engineers.

T-4-115A

Broaching Developments

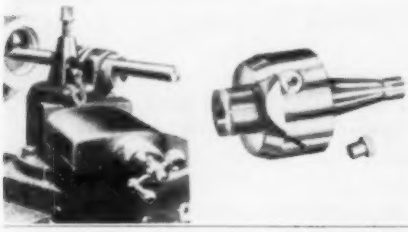
While it is possible that the Colonial Broach Company may not exhibit its latest machines at the ASTE Show—as, for example, the Colonial Dual-Ram Broaching machine, illustrated, with group-mounted standardized controls—the company will nevertheless have an exhibit space—No. 1021—where latest developments in broaching techniques may be discussed with Colonial Broach engineers. **T-4-35**



For further information, use Reader Service Card. See pages 129-130.

Carbide Turning Tools

In accordance with the theme of the ASTE "Cost Cutting" Exposition, the Everede Tool Company will place special emphasis on the carbide Turning Tool, here illustrated along with the other Everede tools. These tools, to be shown in booth No. 311 utilize economical triangular-shaped tool bits of solid carbide.



Equipped with mechanical chip breakers readily adjustable to "on-the-job" conditions, the turning tools eliminate the costly grinding operations and setup time ordinarily necessary to provide chip breakers in the brazed-on type of tool.

Only the tool bit is ground and the Everede holder remains intact, to be used indefinitely as compared to brazed-on tools which, in addition to time lost in backing off the shank, must eventually be discarded. Bits for the Everede tools are available in all leading brands of carbide. T-4-32

Indicate A-4-156-1

Turret Punch Press

A turret punch press—Model RA-41P—that combines the versatility, accuracy and high speed of the pantograph for rapid hole location, will be demonstrated by Wiedemann Machine Company, booth No. 731.

The machine carries 16 to 20 removable stations in the turrets, each of which may be quickly put into piercing position. A stylus point follows a template, and when the work is properly positioned the stylus point engages a template hole and automatically trips the press. T-4-32A

Texaco Cutting Coolants

Exhibited by the Texas Company, booth No. 512, will be a display of Texaco cutting coolants developed to increase production and to provide a better finish at reduced costs. Texaco will also demonstrate a grease breakdown machine, designed to prove the relative merits of various greases—that is, whether or not one may be superior to another. T-4-32B

Reusable Fittings

Ermeto fittings, and reusable hose end fittings, will be included in the exhibit of the Weatherhead Company, booth No. 1041. T-4-32C

"Twist of the Wrist"

Even after the most severe operations, Continental Standard Drive counterbore cutters, to be shown in space No. 440, are hand detachable from the holders. Double driving lugs on the cutter shank engage double abutments in the holder, giving a balanced, positive drive that is not subject to shearing stresses or wedging action. Double bearing areas, one on each side of the driving members, assure rigid alignment of cutter and holder. Manufactured by Continental Tool Works Division of Ex-Cell-O Corporation. T-4-48

Micro Switches

Among the many "Micro" precision switches to be shown by Micro Switch Division is the Micro-Limit precision limit switch, said to be one of the most versatile switches developed for industrial use. This switch combines precision, ruggedness, and adjustability, making it ideal for new as well as replacement switch use.

Other Micro precision switches include a hermetically sealed switch, a small thumb-nail size switch, and a small size double-pole, double-throw switch. Booth No. 557. **T-4-161**

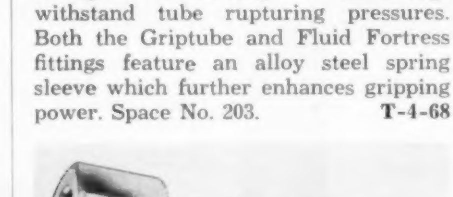
Automatic Screw Driving

Hopper feeds for selection and positioning of parts in assembly will be featured by Detroit Power Screw driver Company, booth No. 939. Also exhibited will be automatic screw driving machines. **T-4-161A**

Hydraulic Fittings

The Flodar Corporation, which manufactures both a flare type "Griptite" fitting—illustrated—and a no-flare type "Fluid Fortress" fitting for installation on machine tools, will display these accessories on a vibrating machine, running constantly, to demonstrate that their products will "stay put" under severe continuous service.

So that visitor may freely judge performance, there will also be a tube rupturing device showing how the fittings withstand tube rupturing pressures. Both the Griptube and Fluid Fortress fittings feature an alloy steel spring sleeve which further enhances gripping power. Space No. 203. **T-4-68**



Carbide Tool Grinder

A new bench-type, universal Carbide Tool Grinder designed especially for use with diamond wheels of all types will be shown by Wickman Manufacturing Company, space No. 109. This machine can be used as a surface grinder, a chip breaker grinder, and a universal tool and cutter grinder.

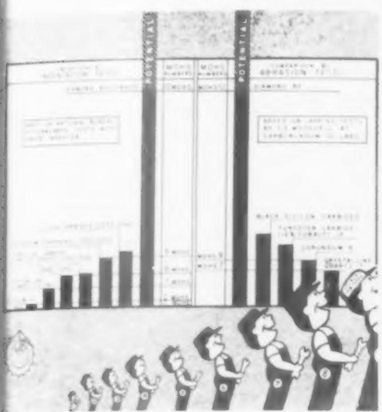
The machine is provided with both a swivelling table and swivelling motor with micro setting scales for accurate grinding and resharpening of cutters, reamers, and counterbores. It is powered with a special 2850 rpm, 1 HP reversing motor, said to be completely free of vibration at this high speed, and which can further be reversed by a lever switch up to 70 times a minute without harming the windings. T-4-36

Tubular Tool Steel

A. Milne Company will exhibit hollow die steel—that is, tubular tool steel, high chrome air-hardening and standard oil-hardening tungsten; chrome manganese; and other alloy steels; also, Timkin graphitic steels will be on exhibit. Space No. 405. T-4-38A

Industrial Diamonds

As a trade association, Industrial Diamond Association of America, Inc., will exhibit all the industry's actual products in six adjacent booths, all in one area. There will be stacks of enlarged photographs of applications, indexed for spot reference. The names of members firms manufacturing diamond tools will be centrally displayed; however, no tools will bear identification marks.



Also featured will be display boards of workpieces, with the tools and end products as used in the home, in travel, recreation, industry, business and in war. A special feature will be the new I.D.A. Hardness Chart demonstrated in a dramatic manner by robots, to indicate that diamond's hardness, from which its superiority derives, registers a minimum of 350% above that of any other abrasive and that its potential relative efficiency is unlimited. Space No. 1071.

T-4-114

Multi Fluted Taps

Hy-Pro Tool Company will exhibit improved designs for their Multi-Fluted Taps. These are special high-speed steel taps with flutes ground from the solid. Perfectly indexed flutes give the user exceptionally free cutting and longer tool life. The exhibitor will show actual case histories, on file, to prove increases such as 125 pieces to 1255 average pieces per tap. Booth No. 1159.

T-4-114A

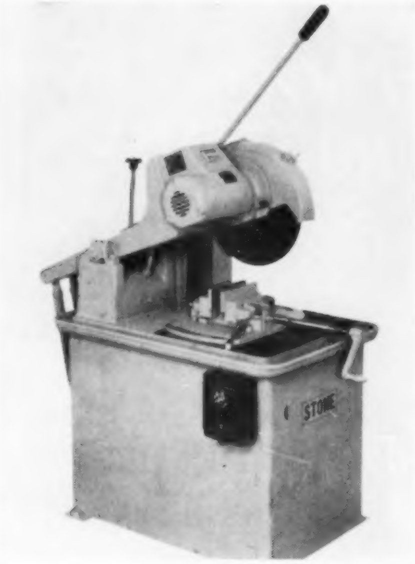
"Air Speed" Tools

Air-Speed Tool Co., space No. 728, will exhibit a line of air-operated tools and equipment including "Air Speed" pneumatic drills, saw and file tools, valve grinding attachments, volume control regulators, a pneumatic lubricator and filter, and special Hi-speed saw blades.

T-4-102

"Swing Cut" Saw

The Stone Machinery Company, booth No. 106, will demonstrate the actual cutting operation of a novel type geared-in-head positive drive Metal Cutting Saw. Using abrasive wheels and hollow ground steel saw blades, cutting in ferrous and non ferrous metals up to 3 in. in solids and 4 in. pipe. The demonstration will show that the Stone "Swing Cut" cuts faster with less burr or burn to any angle up to 45 degrees. **T-4-121**



Fibrex Abrasive Wheels

Simonds Abrasive Company will introduce their Fibrex Red Wheels, a type of synthetic resin bonded grinding wheel of extra strength and durability. Fibrex Wheels are manufactured from laminated sheets of cotton fibre, filled with abrasive, for cutting-off, deburring and finishing operations. Booth No. 516.
T-4-173

Saws and Shears

Circular saws in solid, inserted teeth, segmental type and carbide-tipped will be exhibited by Simonds Saw and Steel Co., booth No. 516. Also shown will be hand and hack saws, power blades, American pattern files, rotary shears, ground die steels and steel specialties.

American Machinist

A McGraw Hill publication, American Machinist is the magazine of metal working production. Booth No. 416.

Shear Clear Face Mill

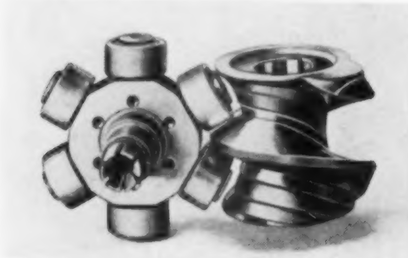
The Ingersoll close-bladed Shear Clear Face Mill with carbide tipped blades, illustrated, was developed for milling cast iron at the high feed rates of 30 to 90 in. per minute. As now designed, a 10 in. face mill has 38 carbide tipped blades, and these cutters are available in sizes of 2 in. in diameter up to any size required.

The Shear Clear cutter permits higher production on present equipment and makes possible late model machines operating at extremely high rates of production. Tool life between grinds is said to have been increased as much as five times. To be exhibited among other Ingersoll products in space No. 950.
T-4-54

1925-1950
Our
Silver Anniversary
SNYDER
ARTHUR COLTON
Marking 25 years of serving American industry through the creation of high-precision special purpose machines for high-production at low unit cost.
SNYDER TOOL & ENGINEERING COMPANY
3400 E. LAFAYETTE, DETROIT 7, MICH.

Intermittent Motion

A precision high speed intermittent Motion Drive, uni-directional in operation, will be exhibited by Ferguson Machine & Tool Co., Inc. Providing precise

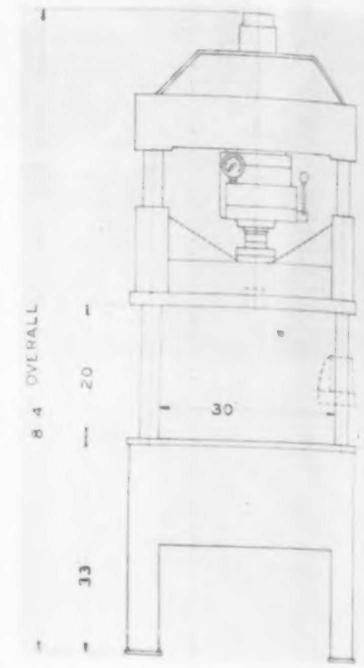


position locking during rest period, the device eliminates additional locking and locating devices. Motion of working period is shockless due to controlled acceleration generated into cams. Drive is applicable to punch press dials, web-fed printing presses, and high speed automatic machinery.

Also shown by Ferguson will be a predetermined electronic counter said to be capable of counting objects or operations at speeds up to 20,000 per second. The counter is pre-set directly to any number from 1 to 999 by a push button keyboard and can be turned off after each cycle or re-cycle automatically. Booth No. 651. T-4-158

Die Try-Out Press

A 50-ton hydraulic die try press known as Model 50-DT, will be introduced by the Dake Engine Company, booth No. 1014. This press is designed to meet the need of the average tool and die shop for trying out dies and for sample or short run production.



The press features power operation of ram in both directions. The ram descends at two speeds, operating at 45 in. per minute in the rapid advance and automatically changing to power advance when pressure reaches one ton. During power advance, the ram will advance at the rate of 3 inches per minute, exerting 50 tons pressure. On the return stroke the ram is capable of a ten ton pull. The press is equipped with guide platens and features a 14 in. stroke. T-4-117

Precision T-Slot Bolts

Exhibited by F. M. Crayton will be T-Slot Bolts designed to overcome traditional shortcomings. Made to Machine Tool Builders standards and to meet high strength requirements of service, these T-slot bolts are forged from S.A.E. 4140.

They are then machined to precise dimensions, hardened and long drawn in an isothermic quench. The design is said to provide 50 percent more bearing surface on the T-slot and to have a tensile strength of about 150,000 psi. Available in sizes ⅜ to 1½ in. diameter and in lengths up to 30 inches. Booth No. 546. T-4-117A

15-inch Drill Press

Atlas Press Company will feature the 15 in. Atlas drill press in floor and bench type, production base and 2, 3, or 4 spindle drills. Available in choice of full-tilting or production oil table, Jacobs chuck or No. 1 or 2 Morse taper spindle. See this production tool in space No. 1008. T-4-117B

Floating Holder

Scully-Jones & Co., space No. 643, will exhibit the "JA" floater holder. The principle employed, unique in floating tool holders although proven in the power transmission field, utilizes a double gear or spline drive coupling to give unrestricted parallel and/or angular float for accurate tapping, reaming and similar operations.

With its use, misalignment between tool and work is said to be instantly corrected, and cutting tools enter holes without "cramping" or bending. Because of its small diameter, this floating holder is said to be ideal for close center and multiple spindle work. **T-4-163**

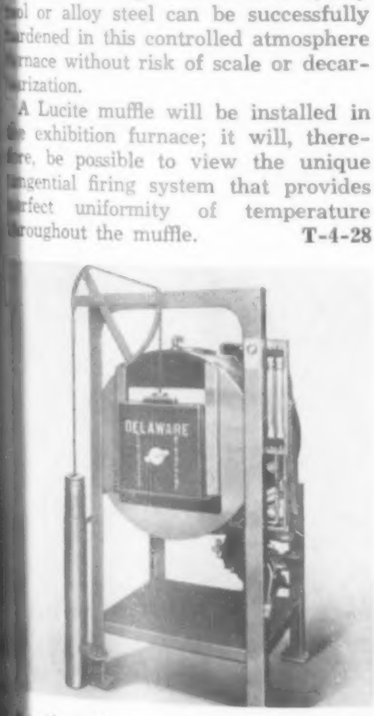
Magnetic Clamping Device

The Hanchett Magna-Lock Corporation will exhibit a magnetic clamping device, consisting of a pair of magnetically actuated clamps so designed that parts of non-magnetic material may be located between the jaws and held firmly against the face of a magnetic chuck for machining purposes. Booth No. 164. **T-4-163A**

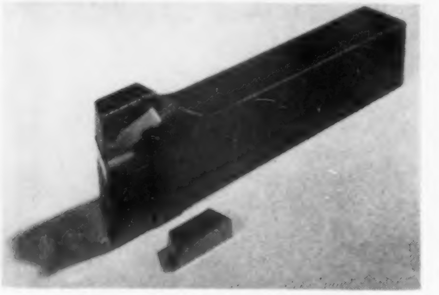
Controlled Air Furnace

On exhibition in space No. 429, the ASTE Show, will be a Model "B" Delaware Controlled Atmosphere Furnace manufactured by the Delaware Tool Steel Corp. Featuring a simplified controlled atmosphere system and a wide temperature range of 1200-2800°F, any tool or alloy steel can be successfully hardened in this controlled atmosphere furnace without risk of scale or decarburization.

A Lucite muffle will be installed in the exhibition furnace; it will, therefore, be possible to view the unique tangential firing system that provides perfect uniformity of temperature throughout the muffle. **T-4-28**



Holder for Tracer Lathes

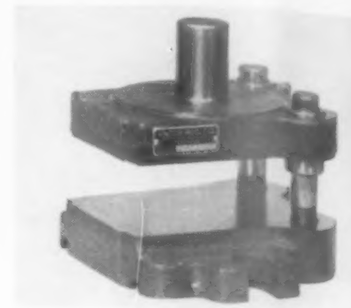


The Viking Tool Company will introduce a holder, for inserted carbide single-point tools, especially designed for tracing or duplicating lathes. This tool incorporates the same novel principle of applying serrations, to carbides, as previously applied to their carbide face milling cutters.

Also to be exhibited by Viking is a line of slotting and side milling cutters in a choice of high speed steel, cast alloy, or carbide inserted teeth. The design provides a dual adjustable cutter incorporating the Viking mechanical lock. Booth No. 108. T-4-188

"Unaloy" Die Sets

Union Manufacturing Company will exhibit "Unaloy" Ultra-Precision Die Sets in space No. 650. Unaloy, developed by Union Mfg. Co., is similar to the material used in Union Chucks and which has contributed so remarkably to the wearing qualities of these chucks. This die set is built in accordance with standards proposed by ASME and are part of a complete die set line being developed by this company. T-4-62

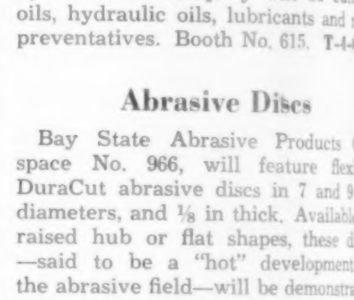


Gulf Oils

Exhibited among petroleum products by Gulf Oil Company will be cutting oils, hydraulic oils, lubricants and rust preventatives. Booth No. 615. T-4-63A

Abrasive Discs

Bay State Abrasive Products Co., space No. 966, will feature flexible DuraCut abrasive discs in 7 and 9 in. diameters, and ⅛ in thick. Available in raised hub or flat shapes, these discs —said to be a "hot" development in the abrasive field—will be demonstrated in actual operation.



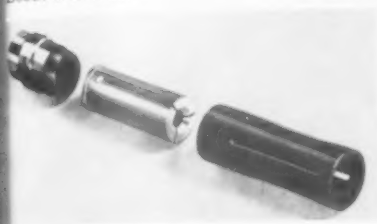
These abrasive discs promise greater economy, longer life, faster and sustained rate of cut in addition to non-tearing qualities that make them safer to use. Available in a variety of grits and grades. T-4-8

Chrome Plating

The Chrome Electro-Forming Company, space No. 955, will have an interesting exhibit of chrome plated parts. While the exhibit will be "static" in that there will be no actual demonstration, the company's personnel will explain "chrome plating to size" whereby new parts may be chrome plated for added life and worn parts restored to usefulness. T-4-98A

The Helix Master

Featured by Sheffer Collet Company will be the Helix Master, which was introduced in the Tools of Today section, February issue of the Tool Engineer. This tool, which is designed for milling of cams without previous layout, will be demonstrated. Also, by Sheffer, will be exhibited a line of Sheffer collets and feed fingers, of which typical examples are illustrated. The Helix-Master, in particular, should be seen by visitors having to do with cam milling. Booth No. 1050. **T-4-128**



Etched Monel

Anderson & Sons, Inc., will feature "Etched Monel", said to be the most recent material to be used in the name-plate industry. A nickel alloy used on ships and sulphuric acid tanks, Monel is tough and resistant to most industrial corrosives. Plates and dials etched on monel will therefore weather the "tough spots" in industry.

Also exhibited by Anderson & Sons will be a complete line of engraved, embossed, lithographed and etched instrument panels, nomenclature plates for all industrial applications in addition to plaques, service awards, novelty and souvenir items. Booth No. 329.

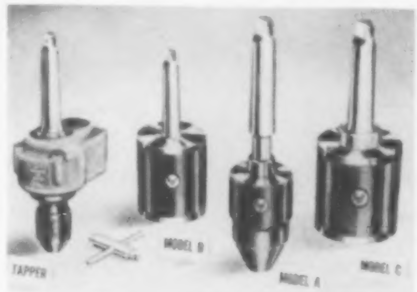
T-4-128A

Grinder-Millers

Precise Products Company will feature the "Precise" Grinder-Miller mounted on such machine tools as a Gorton duplicator, a Bridgeport vertical mill, and a South Bend precision lathe. Accurate and having a speed range of 10,000 to 45,000 rpm, these attachments may be applied to internal, external, cylindrical and form grinding and to milling and finishing operations using tungsten carbide midget mills. Booth No. 441. **T-4-166**

Chucks and Saws

American Machine & Foundry Company will exhibit a complete line of

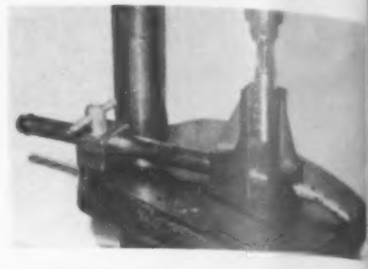


fully automatic drill chucks and tapping attachments, products of the Wahlstrom Tool Division. A number of these tools are illustrated. The Wahlstrom Model "A" is a fully-automatic chuck that requires no keys, collets or wrenches to lock the jaws—a slight hand-grip while running does the trick—and the jaws are fully self-centering.

DeWalt, Inc., also a subsidiary of American Mach. & F'dry. Co., will exhibit the DeWalt Woodworking Machine and the DeWalt Radial Arm Saw. The latter is practically 10-tools-in-1 in that it can make any type of straight-line cut at any angle. Both displays in space No. 659. **T-4-81**

Indicate A-4-165-1

Safety Drill Vise



The Float-Lock Corporation will introduce the Float-Lock safety drill press vise which, as the name implies, is a full floating vise incorporating safety features. Free to swing clear of the table, or to any position on the table, it may be used vertically or on the sides to hold work and to prevent it from turning with the drill. Booth No. 4

T-4-192

Print-Making Equipment

Ozalid, Division of General Aniline & Film Corporation, will have in operation its "Ozability" system, used to cut copying costs in both shop and office.

Illustrating Ozalid's recent improvements in print-making equipment will be the current Printmaster, Super-B, and Streamliner models. Also shown will be a complete line of Ozalid sensitized products and demonstrations of savings in duplicating drawings, records and reports of all kinds. Space No. 537. T-4-192A

Multi-Drills

The Commander Mfg. Co., space No. 426, will exhibit the Commander Multi-Drill, here shown set up for production drilling in a California plant. Quickly set up to any hole pattern on or within a 9 in. circle, these Multi-Drills offer maximum flexibility and efficiency at low initial tool cost.

Available with from 2 to 8 spindles, they fit practically any drill press. Minimum center distance ½ in., and drill sizes accommodate range from 1/16 to ⅝ in. Special adaptions are available.

T-4-88

Gages by Starrett

A feature of the L. S. Starrett exhibit,

booth No. 322, will be the official introduction of 25 tools added to the company's lines of precision measuring tools and dial indicators.

Among the latter is the portable dial hand gage No. 1015, designed for rapid thickness gaging of such soft materials as rubber, textiles and leather, as well as metallic materials and such "in-between" materials as plywood and cardboard.

Also to be introduced is the Starrett vernier height gage No. 354, which features a slotted base that permits direct reading or line scribing at any point from the base surface up to the limit of measuring range. T-4-168

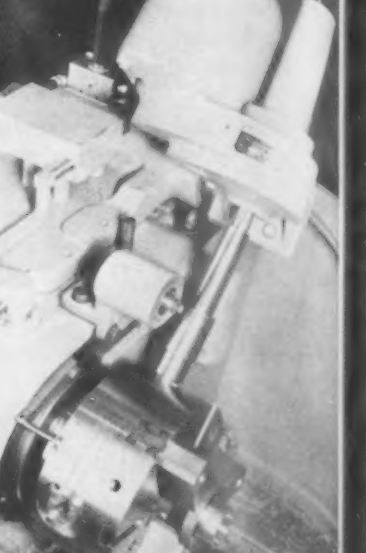
"Chrome Clad" Micrometers

The Lufkin Rule Company, space No. 508, will feature their "Chrome Clad" micrometers among a broad line of Lufkin measuring tools and instruments. All Lufkin micrometers—outside, inside and depth—are now furnished with chrome-clad finish on all reading surfaces.

The full polished outside micrometers are fully chrome clad, distinguishing the dull satin-chrome finish with jet black markings. This finish implies easy reading, longer wearing markings, and high resistance to rusting. T-4-166

Demonstration by Cushman

The Cushman Chuck Company will have working demonstrations of the company's line of chucks. These demonstrations will emphasize simplified operations with faster and less costly tooling and setup, reduction in floor-to-floor-time and in operator fatigue through use of power applications.



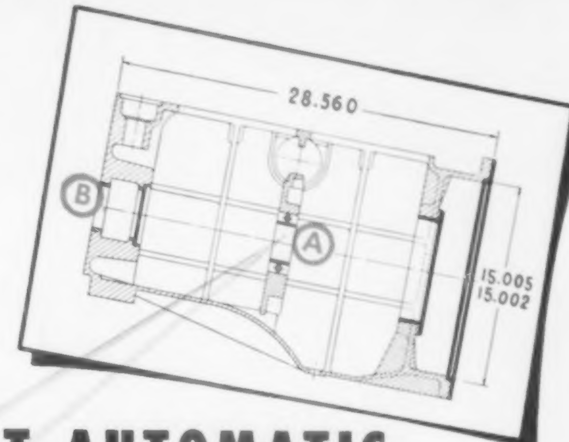
Among specific features of the exhibit will be an operating model of a high speed aluminum body air-cylinder, illustrated, for use with power chucks and designed to operate at spindle speeds up to 6000 rpm. Booth No. 866. T-4-157

Precise and regular as clockwork...

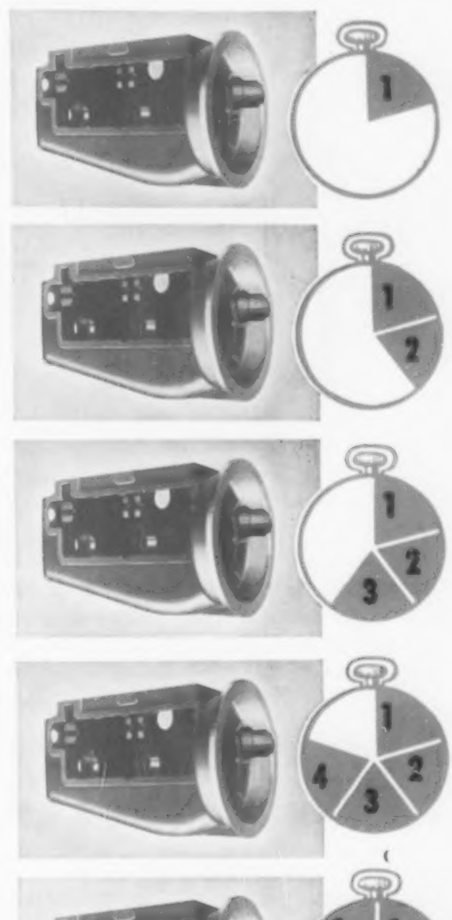
5 PER HOUR

ON THE

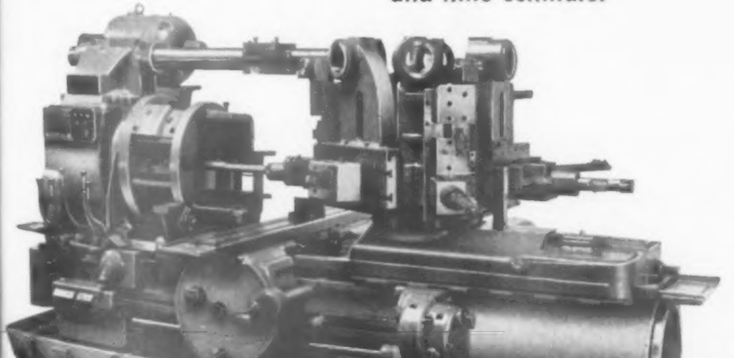
POTTER & JOHNSTON 8DXT AUTOMATIC



23 operations on this Crankcase are indicated by the heavy lines in the drawing — all precision-machined *in one holding* on the P&J 8DXT. The smaller size of the middle bore "A", in relation to the back bore "B", presented a problem. Skillful P&J Tooling solved it, and delivered excellent productivity by completing the job at the rate of one *Crankcase every 12 minutes* at 85% efficiency.



It's the combination of the P&J Automatic and P&J Tooling — in this case the special work-holding fixture plus the P&J-engineered cross slide and turret Tooling — that accounts for the elimination of all unnecessary work handling. Many cuts are combined, and machining time is lowered. As a result, operating costs are greatly reduced. You can attain the same economy-advantages in any multiple operation work on castings and forgings by getting a P&J Tooling recommendation. Simply send a sample part or prints for a tooling and time estimate.



8D T AUTOMATIC

for ork requiring up to 36"
wing over bedways

Potter & Johnston Company

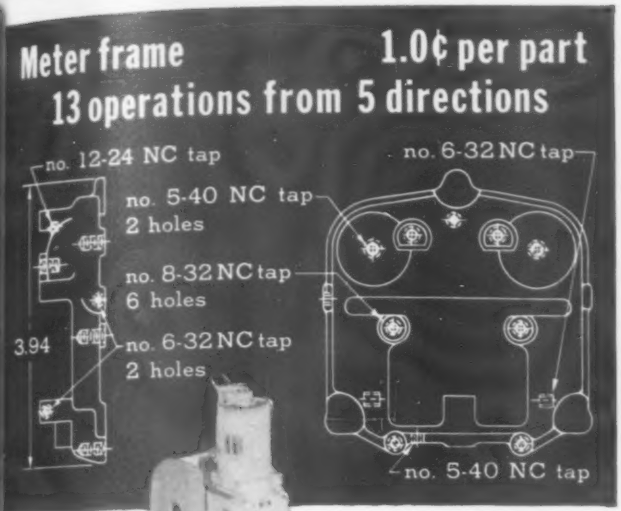
Pawtucket, R. I.

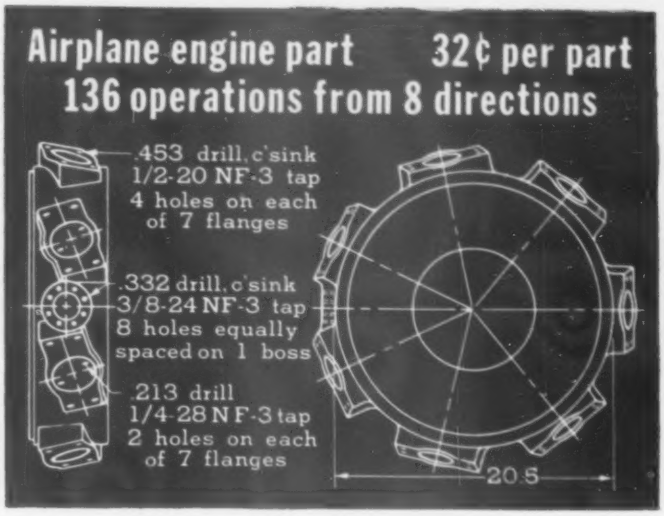
subsidiary of Pratt & Whitney Division Niles-Bement-Pond Company

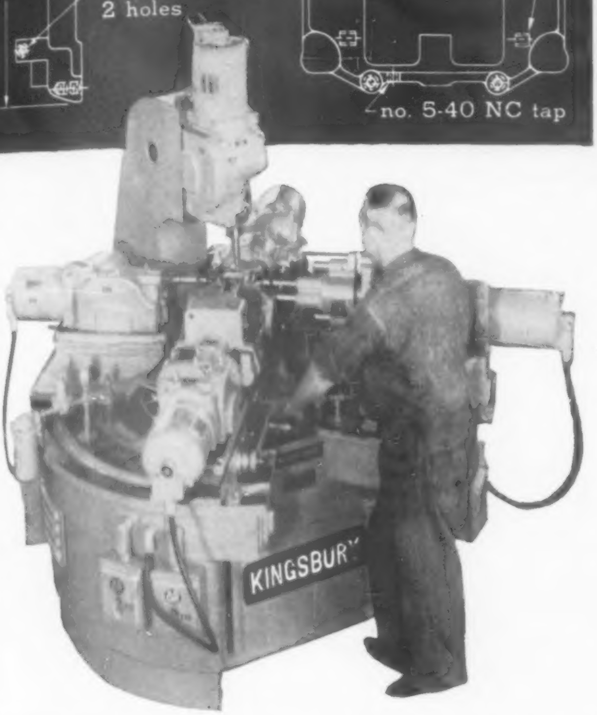
P&J

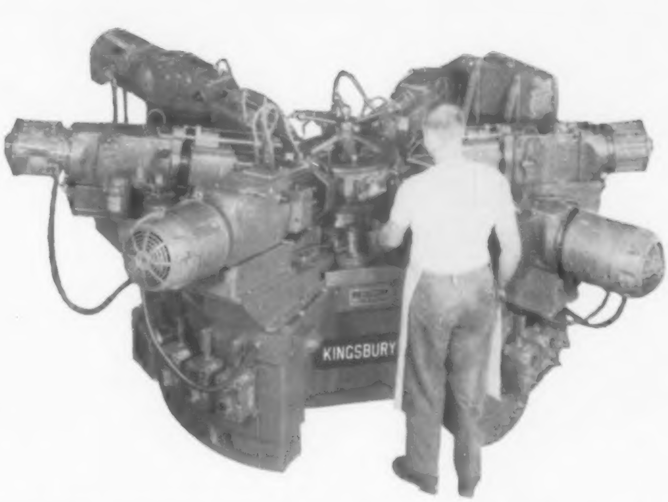
Indicate A-4-169-1

For further information, use Reader Service Card. See pages 129-130.









960 PARTS AN HOUR GROSS. One vertical and four horizontal units tap five sides of the same part at the same time. There is no indexing. Three units have multi-spindle auxiliary heads. Two Kingsburys ahead of this setup drill these and other holes.

21 PARTS AN HOUR GROSS. One part at a time indexes on its axis, 1/7 turn per index. Three angular units drill the flanges after indexes 1 to 7, countersink after 2 to 8 and tap after 3 to 9. Three horizontal units do the eight holes after indexes 1 to 3.

t cost and increase output

pend most of their time on proposals and machines for our customers.

The crucial moment

Your Kingsbury arrives. (Ten to one it's on time.) You remove the skids and rust-proofing, level it, connect the power and air lines, run off samples and inspect them. You call the front office. "That new Kingsbury is in production. Do you want to see it?" It is as simple as that.

That is one reason why plants keep on buying Kingsburys. Since the last war ten plants have paid us $4,072,690 for new equipment, none of these ten under $200,000. (Don't let this scare you. Some plants may require only *one* Kingsbury.)

Can we save you money?

It costs nothing but a little time and a stamp to get a firm proposal. Just send a print to our Mr. L. A. Carll. Tell him the operations and hourly output you need. Or ask him for free bulletins showing 53 setups.

Sincerely,
Kingsbury Machine Tool Corp.
120 Laurel Street, Keene, N. H.

About the costs on the drawings

Each unit cost includes the man and machine on all operations shown – no power or overhead. We assumed three things: 1) 80% efficiency, 2) Each man's wage rate would equal the national average for such work, 3) The entire cost of each machine and tooling would be paid for after only 6000 hours of operation, a fraction of its useful life.

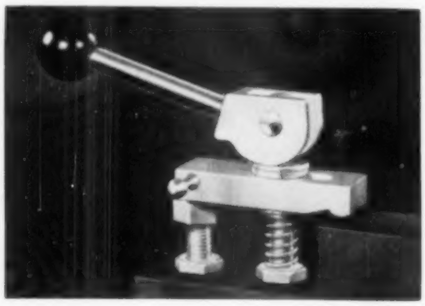
KINGSBURY

AUTOMATIC DRILLING & TAPPING MACHINES
for Low-Cost High Production

Indicate A-4-171-1

Clamps and Mounting Bolts

Produced to save in cost of designing and tool making, Wespo Fixture Clamps for work holding come in 12 types and 94 sizes. Spherical washers allow clamps to float and to compensate for irregularities in the work—as for example, note the quick action center cam clamp illustrated.



Wespo mounting bolts, bolster bolts and T-bolts are made to J.I.C. Standards and reduce cost by holding dies and bolts to plates more securely and lengthening their lives. Bolster bolts are available in sizes up to 1½ in. dia., heads square to 3 in. or hex. 2⅝ in., T-bolts ½ to 1 in. diameters, lengths 4 to 22 inches. Products of West Point Mfg. Co., these tools will be shown in booth No. 1141. **T-4-24**

Overload Control

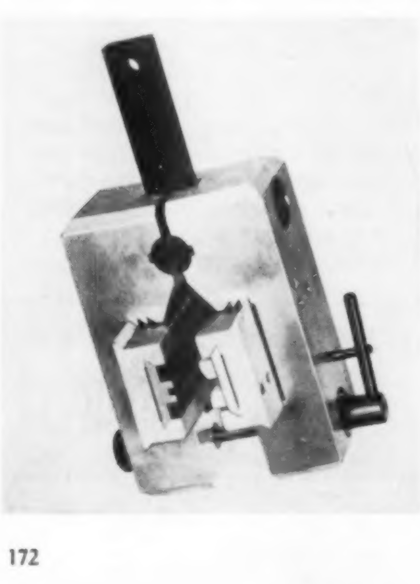
The Brinnell Company, booth No. 567, will feature the Protectron, an electronic control to prevent overload of motors and electrical equipment. **T-4-24A**

Small Parts Feeders

Vilerating feeders for small parts will be demonstrated by the Syntron Company, booth No. 24. **T-4-24B**

Honing by Sunnen

Sunnen Products Company will introduce recent honing tools, including the external hone, illustrated, and the Honall. The latter tool is designed for sizing and finishing holes requiring geometric accuracy and fine surface finish. A portable tool, it can be taken to the work and is therefore applicable to a wide range of honing operations. Booth No. 531. **T-4-202**



Drawing Compounds

In addition to cutting and quenching oils, Shell Oil Company, Inc., will feature hydraulic oil compounds for deep drawing of metals. Also on exhibit will be late developments in rust preventatives. Booth No. 922. **T-4-202A**

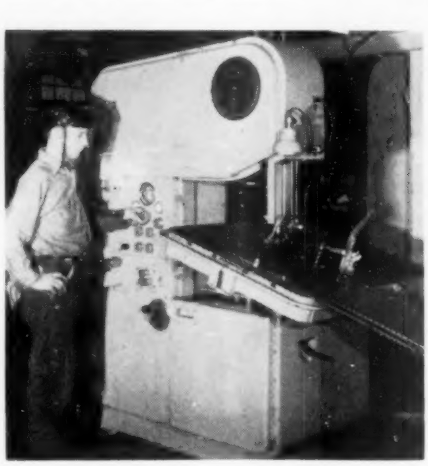
"Cut-aways" by Socony

Socony-Vacuum Oil Co., Inc., will have a specially designed background with explanatory text and full-color illustrations of "cut-away" machines using Socony-Vacuum products in metal processing operations. Booth No. 1035. **T-4-202B**

The 1950 Contour-Matic

The 1950 DoAll Contour-matic, by the DoAll Company, is a completely hydraulic manufacturing machine tool operated from a centralized control panel. Work feed, machine operating speed, tool posts, brakes and work table tilt are all hydraulically operated.

This machine provides facilities for band machining every known solid material, whether it be glass, hardened steels, wood, plastic, rubber, or other machineable materials. Having from 40 to 10,000 fpm infinitely variable speed, it uses anyone of 27 band cutting tools developed specifically for efficient cutting of all solid materials.



Chief of these tools is the Line Milling Band and Line Grinding Band so that line milling, line grinding, honing, and abrading operations can be performed on tough hardened metals and vitreous materials. This machine, and other DoAll equipment, will be shown in space No. 121. **T-4-15**

Riveting Equipment

Riveting machines and attachments will be exhibited by Edwin B. Stimpson Company, booth No. 647. Also shown will be sample stampings and parts produced by this equipment. **T-4-15A**

Industrial Oils

Displayed by Wynn's Friction Proofing Oil will be a line of industrial oils; also, an inhibitor to oil to create a tough film to prevent metal-to-metal wear. Booth No. 19. **T-4-15B**

Exhibit and Plant Tour

Tinius Olsen Testing Machine Company will exhibit testing equipment including the L. C. Type, a dual capacity machine 10,000 and 1,000 lbs.—designed for standard tensile, compression and transverse tests of metals and other products.

Also, Olsen will introduce the Type EAA Electodyne indicator, developed for use with Olsen Type E-O balancing machines. In addition to the exhibit at the Show, booth No. 1146, the company invites visits to the plant, located in suburban Philadelphia. **T-4-196**

Diamond Abrasive

The Industrial Products Division, Elgin National Watch Company, will introduce its latest development in diamond abrasives—the Elgin "Dymo".

This abrasive, which is available in eleven Bureau of Standards grades, is said to cut faster and to go farther because precision-graded particles of pure diamond, compounded with an exclusive Elgin vehicle, do the cutting.

Universal solubility for easy clean-up after polishing, distinct color indentification for quick selection of grades, and convenience for production shop application, are said to all make Dymo truly a "Tool of Today" in production finishing. Booth No. 306. **T-4-196A**

Looking for savings?

48% PRODUCTION BOOST REPORTED ON THIS OPERATION

Here's a Kearney & Trecker Chucking Table milling machine with automatic cycle and Mono-Lever Control giving a 48% boost to production of this worm wheel housing. Mono-Lever Control and automatic table operation is the answer.

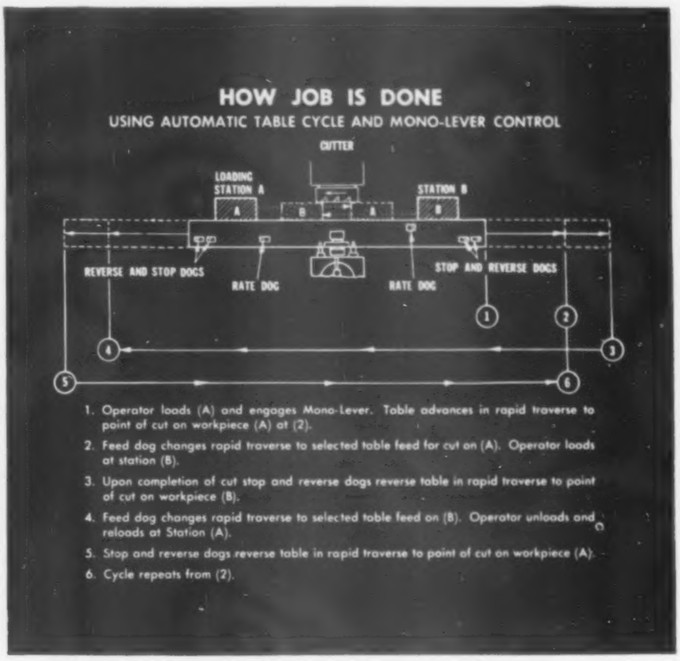


Diagram shows setup for reciprocal milling. Operator engages Mono-Lever only once for entire run — spends the rest of his time loading and unloading workpieces. Table moves constantly, idle cutter time is at a minimum.

COMPARE

Production by old method.

Production gain using a Kearney & Trecker Milling Machine with Mono-Lever Control and Automatic Table Cycle.

48%

HERE'S GRAPHIC PROOF OF SAVINGS RESULTS

16% 16%-49% 49%-96%

1. The minimum over-all savings reported from any job when done on a Kearney & Trecker Milling Machine with Mono-Lever Control and Automatic Table Cycle.
2. The *majority* of over-all savings from jobs done on these machines fall here.
3. Under favorable conditions, several jobs done on these machines have shown savings like this!

When it comes to boosting production — there's nothing else like them. We mean Kearney & Trecker Milling Machines with Mono-Lever Control and Automatic Table Cycle.

Take a look at the job described here and the bar graph at lower left. See how these machines have cut milling costs for others *16%* to *96%*! Yes, and they can do the same for you!

Contact us or our nearest representative. Get proven facts on how Kearney & Trecker's milling machines with Mono-Lever Control and Automatic Table Cycle can cut your costs, increase your savings. Kearney & Trecker Corp., 6784 W. National Ave., Milwaukee 14, Wis.

KEARNEY & TRECKER MILWAUKEE MACHINE TOOLS

Indicate A-4-173-1

For further information, use Reader Service Card. See pages 129-130.

INCREASE PERCENTAGE OF GRINDING TIME

with these

2 ADVANCE-DESIGN AUTOMATIC CYCLE ARRANGEMENTS

THE NEW Automatic Cycle and Spark-Timing Arrangement and the new Automatic Cycle and Sizing Arrangement make Brown & Sharpe Plain Grinding Machines even more productive and versatile. They assure extremely-rapid uniformity of sizing and finish, practically full-time grinding, a minimum of rejects . . . with less effort and attention from the operator.

A UNIQUE FEATURE common to both Arrangements is the *direct-contact wheel-to-work manual infeed* at the start of the cycle. This feature permits larger work tolerances in preceding operations. It eliminates the need of set-ups that favor the high limit of previous turning tolerances. Non-productive time is out . . . no "air-cutting" —net result, appreciably lower overall machining cost.

ANOTHER IMPORTANT FEATURE common to both arrangements is *ease of disengagement*, whereby the machines are instantly available as standard plain grinding machines.

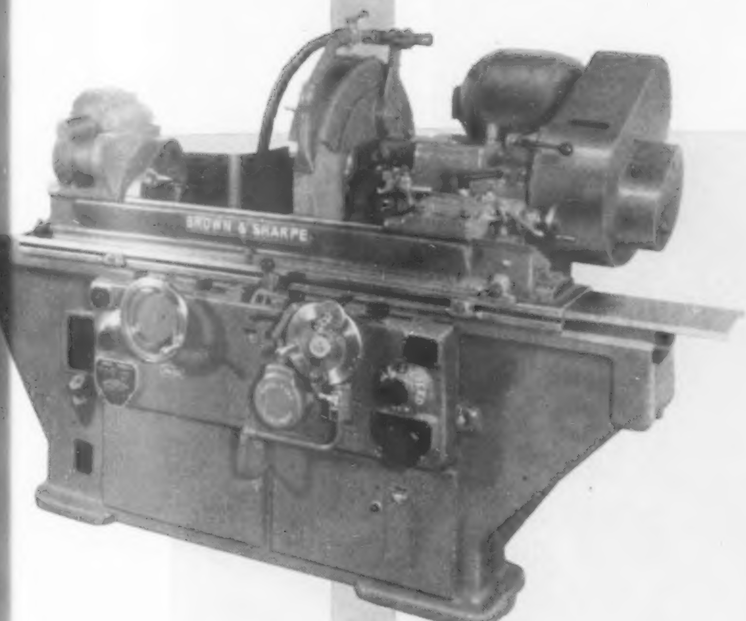
Investigate these new opportunities to reduce your grinding costs still further. Highlights of each arrangement given on opposite page. Arrangements available on all Brown and Sharpe Plain Grinding Machines. Write for complete details. Brown & Sharpe Mfg. Co., Providence 1, R.I., U.S.A.

1. Immediate contact with work.

2. "Air cutting" on conventional machines with automatic cycle.

These two diagrams show the advantage of Brown & Sharpe infeed over conventional automatic cycle infeeds. **1.** Brown & Sharpe infeed brings grinding wheel into immediate contact with work by a continuous smooth sweep of handwheel . . . provides initial grind before cross-feed pawl is engaged. **2.** With conventional infeed, wheel must approach work on slow feed.

BROWN &



No. 22 Plain Grinding Machine with Automatic Cycle and Spark-Timing Arrangement.

AUTOMATIC CYCLE AND SPARK-TIMING ARRANGEMENT

On plunge-cut or transverse grinding where uniformity of sizing and finish is essential, this arrangement automatically controls spark time and operation at a predetermined rate (spark time adjustable from 2 to 180 seconds). After grinding is completed, wheel slide withdraws automatically, headstock stops and coolant is shut off. Arrangement used with reciprocating table employs normal amount of spark time allowed for traverse grinding without automatic cycle. Handwheel operation provides positive protection against automatic cycle starting accidentally.

No. 10 Plain Grinding Machine with Automatic Cycle and Sizing-Arrangement.

AUTOMATIC CYCLE AND SIZING ARRANGEMENT

For longer production runs on plunge-cut grinding, where uniform sizing and finish to .0001″ are desired, this arrangement offers maximum output at minimum cost and effort. It automatically sizes from the work—eliminates compensating for wheel wear and effects of wheel truing. After loading and three simple hand operations, cycle is completed automatically. When wheel approaches within .001″ to .003″ (pre-set on work sizing gage) of finish size, cycle changes from coarse feed to predetermined fine feed.

THESE TWO NEW ARRANGEMENTS NOW AVAILABLE on the following Brown & Sharpe Plain Grinding Machines: No. 5—Nos. 10 & 12—Nos. 20, 22 & 23.

SHARPE B·S

Combined Filter-Regulator

C. A. Norgren Company will feature its Filter-Regulator, which combines both function in one compact unit only 11 in. high. Designed to filter air and non-corrosive gasses at pressures up to 125 psi, the unit may be installed as original equipment on production machines and as plant equipment for spray-painting lines, instrument control, and other industrial service. This, and other Norgren products, will be demonstrated in space No. 635. T-4-37

Angle Drives by Donovan

Among the interesting and novel displays at the ASTE Show will be working model of Angle Drives by the Donovan Company. These drives, which operate without gears and have many industrial applications, will be shown in operation at various angles. Booth No. 1. T-4-37A

Carbo-Mills and Burs

Severance Tool Industries, Inc., will exhibit a full line of their Carbo-Mills in booth No. 953. These midget mills, which have a wide range of uses and which further have useful life far beyond that of steel burs, can be reground when finally dull at a fraction of original cost. Such regrinding restores them to new condition. T-4-18

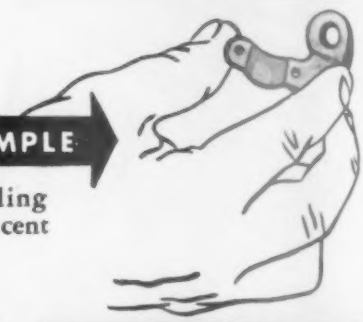
For further information, use Reader Service Card. See pages 129-130.

VISIT BOOTH 802 AND SEE HOW THE COST OF DRILLING THESE THREE HOLES WAS CUT 50% with BELLOWS "*Controlled-Air-Power*"

"The split penny savings we make on secondary operations through Bellows "Controlled-Air-Power" helps keep our competitive position solid."

HERE'S ONE EXAMPLE

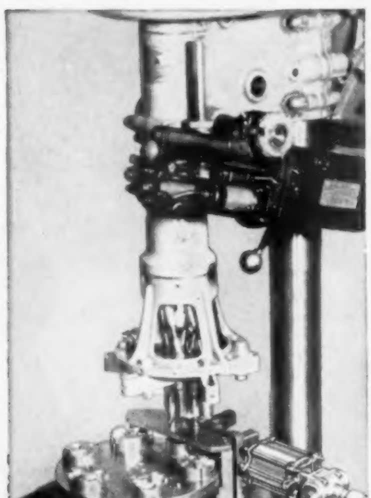
"We cut the cost of drilling these three holes from ½ cent to ¼ cent



HERE WAS THE PROBLEM

THIS WAS THE SOLUTION

IT CUT DRILLING COSTS FROM ½ CENT TO ¼ CENT PER PART



HERE'S HOW

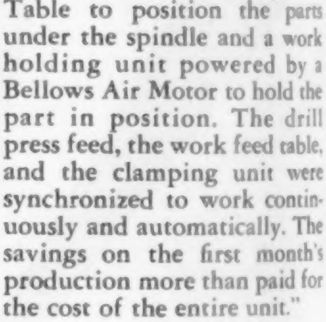
"We had been drilling these holes one at a time on hand-fed drill presses. The run wasn't long enough to warrant expensive drilling equipment but was too long for the costly way we were doing it.

"At the suggestion of a Bellows Field Engineer we installed a Bellows Feed to feed the drill spindle, a Bellows Rotary Feed Table to position the parts under the spindle and a work holding unit powered by a Bellows Air Motor to hold the part in position. The drill press feed, the work feed table, and the clamping unit were synchronized to work continuously and automatically. The savings on the first month's production more than paid for the cost of the entire unit."

Write for the FOTO FACTS FILE

• The actual set-up is duplicated in The Bellows Company Booth 802. Come in and see how you, too, can use "Controlled-Air-Power" to cut your costs — whether your plant is large or small.

We'd like you to see other typical case histories showing how Bellows "Controlled-Air-Power" Devices are helping alert management cut costs. Write for your copy of the Foto Facts File today. It's full of practical suggestions, photos, wiring diagrams, cost and production figures — helpful information you can apply to your own production problems to make your profit picture brighter.



The Bellows Co.

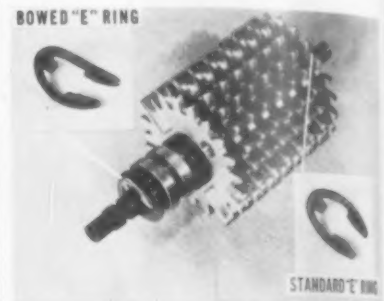
AKRON, OHIO

MANUFACTURERS OF AIR MOTORS • AIR CYLINDERS • AIR POWERED FEEDS • AIR VISES • AIR-HYDRAULIC VISES • AIR POWERED ARBOR AND IMPACT PRESSES

Indicate A-4-178-1

"Truarc" Retaining Rings

Waldes Kohinoor, Inc., will include as part of their exhibit many recent field applications of all types of Waldes "Truarc" retaining rings, such as the "E" rings, illustrated, and the Truarc triangular rings; also, several self-locking type rings.



In addition, there will be recent developments in retaining rings such as those designed to take up end play. These rings will be demonstrated and shown in actual application. Booth No. 1135.
T-4-181

Controlled Rake Angle

The high light of the Edward Blake Company exhibit will be their Flute Grinder which, demonstrated, will show the possibility of controlled rake angle on the cutting teeth of taps and thus providing the benefits that controlled rake angle gives to any metal cutting tool. The display will be supplemented with their tap chamfer grinders, drill grinders and other products. Booth No. 919. T-4-181A

Reproduction Equipment

Eugene Dietzgen Company will display drawing instruments, slide rules, engineering and reproduction equipment. Booth No. 865. T-4-181B

Tool Control

McCaskey Tool Crib Control will be demonstrated in space No. 551 at the ASTE Show. The system here partly illustrated is arranged for control of tungsten carbide tools, and provides control of over 2000 tool items loaned to 360 men employed by one user.

Because of the tremendous interest in carbide tools, the McCaskey Register Company believes that their exhibit will be a "feature product" of the Exposition. Certainly it will attract cost accountants and tool supervisors having to do with tool control. T-4-69

See it in operation at the TOOL ENGINEERS SHOW—Booth 105

NEW AUTOMATIC POWER FEED

walker-Turner
DIVISION

ON THE WALKER-TURNER 16" BAND SAW

Just one of many examples of how Walker-Turner machine *design* helps the metalworking industry

CUT PRODUCTION COSTS

If you're interested in more efficient production methods (and who *isn't* these days!), you'll make the Walker-Turner Booth — 105 — your first stop at the A.S.T.E. Exposition in Philadelphia.

You'll want to see such outstanding developments in machine design as the new Automatic Power Feed, which makes the Walker-Turner 16" Band Saw truly a *cost-cutting* machine.

You'll want to inspect and operate the other machines in this complete line . . . to see at first hand how Walker-Turner *design* helps you do a better job . . . faster . . . for less.

So whatever you do, wherever you go at the Tool Show, don't miss Walker-Turner's "Cost-Cutting" Exhibit at Booth 105.

DRILL PRESSES • RADIAL DRILLS • TILTING ARBOR SAWS
BELT and DISC SURFACERS • METAL CUTTING BAND SAWS

See you at the Show!

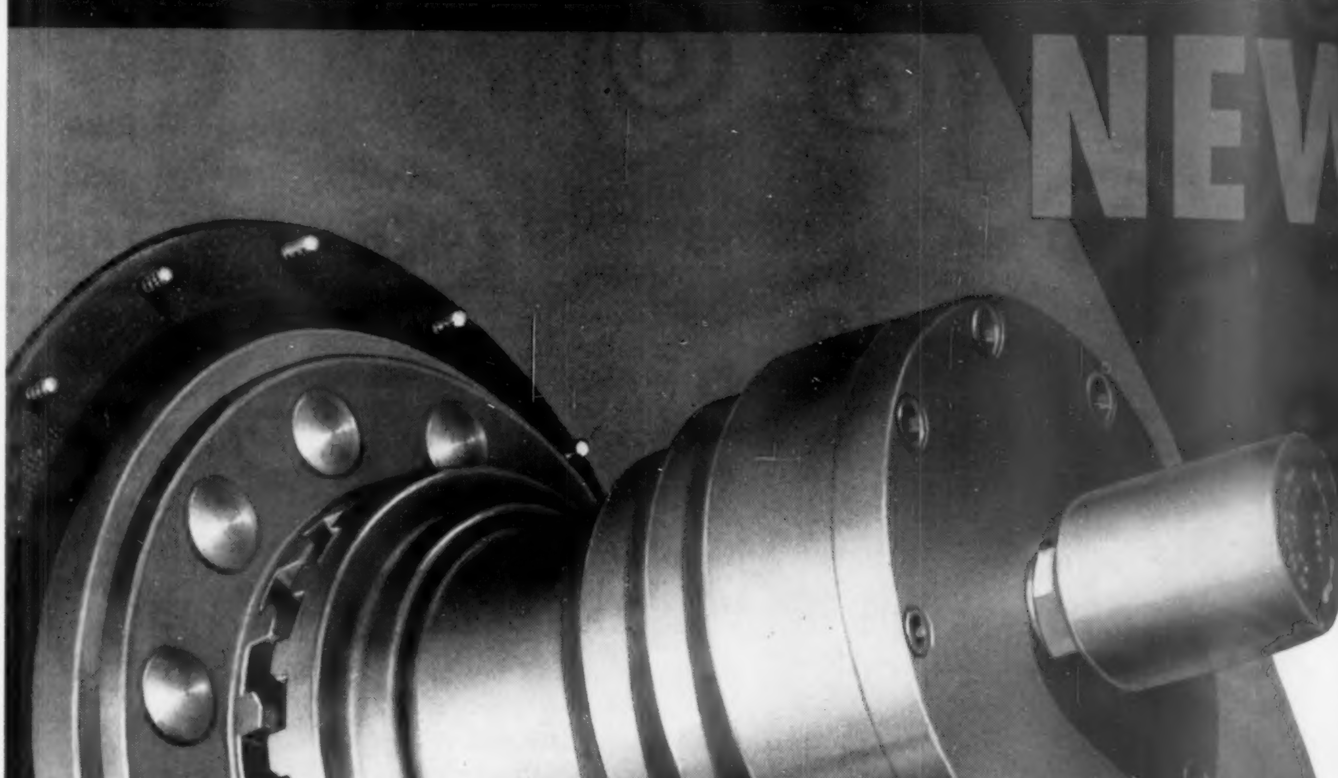
KEARNEY & TRECKER
MILWAUKEE

WALKER-TURNER DIVISION

PLAINFIELD, NEW JERSEY

Indicate A-4-181-1

NIAGARA



This most revolutionary improvement in press design since Niagara introduced the world famous sleeve clutch in 1934 has been in the process of development and testing for many years. It is patented and there are patents pending.

Its high hourly output . . . its sturdiness . . . its simplicity . . . its labor saving and maintenance economies . . . its safety features . . . are amazing.

ANNOUNCES
SLEEVE CLUTCH
electrically controlled air actuated

DeLuxe Control

Note each one of these outstanding features:

all the advantages of a friction
ch.

all the advantages of a Sleeve
ch.

be engaged or disengaged at
point in the stroke.

be jogged through the full 360°
rankshaft travel.

be stopped instantly, regardless
position of crank, by stop button,
ric eye, limit switch or high
uency electric field.

6 Can be operated by palm buttons, foot switch or push buttons.

7 Can operate single stroke or continuous.

8 Provides positive drive.

9 Has no friction members to wear.

10 Generates no heat.

11 Has low air consumption.

12 Makes instant engagement.

13 Provides effortless operation.

14 Is located on outside of drive wheel.

15 Can be completely removed without taking off the drive wheel.

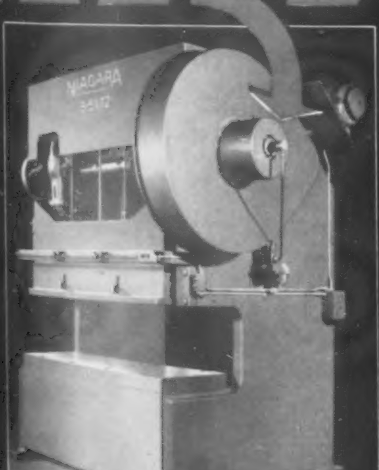
16 Drive wheel next to frame . . . minimum overhang.

17 Drive wheel runs on anti-friction bearings.

18 Gears and clutch run in a bath of oil.

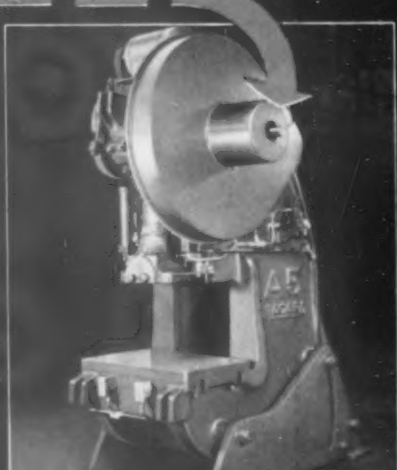
19 Has few moving parts. Integral jaws and splines.

20 Presses so equipped are provided with air releasing brake.



For Double Crank Gap Presses

For Straight Sided Presses



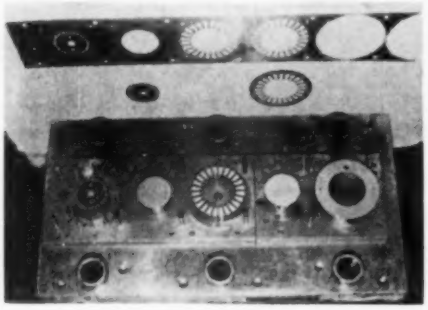
For Inclinable Presses

GARA MACHINE AND TOOL WORKS, BUFFALO 11, NEW YORK

DISTRICT OFFICES: DETROIT, CLEVELAND, NEW YORK

Vasco Supreme Steel

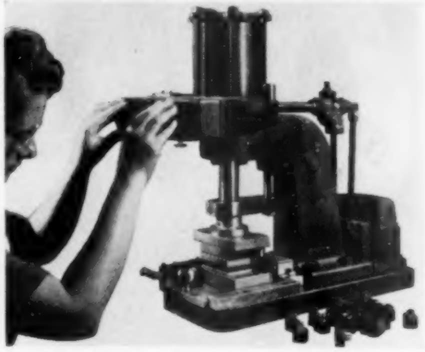
Production economies are achieved by use of Vasco Supreme, a high-speed steel recently developed by Vanadium-Alloys Steel Company. Containing 1.50% carbon and 5% vanadium, Vasco Supreme can be placed in service at a higher hardness and, as claimed, with greater wear resistance.



Successful uses range from cutting tools such as form tools, milling cutters, broaches, drills and tool bits to a wide variety of die and wear resisting applications.

A typical use of Vasco Supreme is illustrated. As claimed, this die—which blanks laminations for small electric motors from silicon steel sheet—produced 175,000 pieces per grind with Vasco Supreme as compared to 80,000 pieces per grind when made of the former tool material. See this steel displayed in space No. 666. T-4-97

Air-Operated Press



In addition to improved air control valves recently announced in these columns, Hannifin Corporation will have on display its small, air-operated press—the ½-ton Han-D-Press, Model M-1. Hannifin describes this press as fast-operating, semi-automatic, and moderately priced.

It is especially applicable to press fit assembly operations, such as in the manufacture ef electric motors, small tools, and bearing parts, and to staking operations, as in the assembly of radio parts. It is also suitable for light stamping, marking, and die cutting operations. Space No. 215. T-4-159

Electrical Motors

Electrical motors and testing equipment will be displayed by Simpson Electric Company, booth No. 714. T-4-159A

Gear-Type Hydraulic Pumps

Adel Precision Products Co., space No. 1040, will exhibit a line of gear-type hydraulic pumps for industrial and farm equipment applications. Designed for 1000 psi service, these pumps are available in various models with rated capacities, at 1800 rpm, from 1.5 to 60 gpm. Each model may be had in a choice of mountings. The Series "B" pump is illustrated. T-4-101

Hydraulic Appliances

Galland-Henning Manufacturing Company will have an extensive exhibit of hydraulic equipment and appliances, including Nopak air and hydraulic valves and cylinders for control of fluid power. Designed for use as component parts of machinery or equipment benefiting industry. Booth No. 844. T-4-101A

NEW!

TRY

SIMONDS ABRASIVE CO.

FIBREX® RED WHEELS

TRADE MARK

For EXTRA LONG WHEEL LIFE, versatility, fast cutting, here's your answer . . . Fibrex Red Wheels. They're strong, tough durable for truly outstanding action in heading into welds, removing flash and bead and cleaning up rough ragged surfaces, especially on stainless steel.

Depressed Center Wheels (with adaptor) for all portable disc sanders and right angle grinders . . . straight wheels for cutting and all purpose grinding with regular equipment. Your choice of grain sizes . . . 16, 24, 36, 50 or 80. Send now for Bulletin ESA 186 giving full details on these new and amazingly versatile abrasive tools.

SIMONDS ABRASIVE COMPANY, PHILADELPHIA 37, PA. DISTRIBUTORS IN PRINCIPAL CITIES

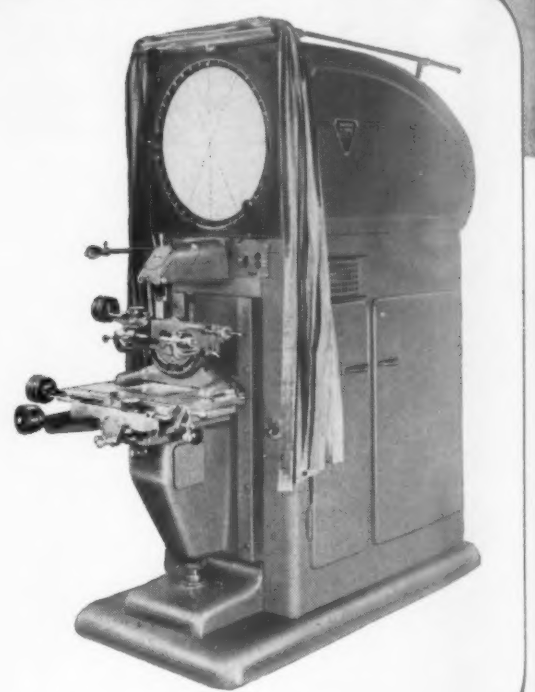
Indicate A-4-185-1

DIVISION OF SIMONDS SAW AND STEEL CO., FITCHBURG, MASS. OTHER SIMONDS COMPANIES: SIMONDS STEEL MILLS, LOCKPORT, N. Y., SIMONDS CANADA SAW CO., LTD., MONTREAL, QUE., AND SIMONDS CANADA ABRASIVE CO., LTD., ARVIDA, QUE.

LOWER COSTS OF PRODUCTION OF INSPECTION

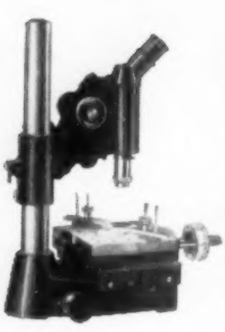
WITH THESE
BAUSCH & LOMB PRECISION INSTRUMENTS

CONTOUR MEASURING PROJECTOR



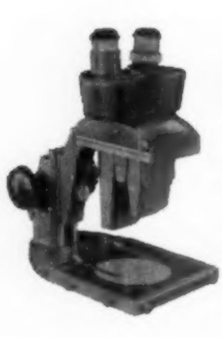
You save time and money by assuring *more accurate measurements than any other projector can give you.* You get angular measurements to ± 1 minute of arc, with the protractor screen. You get direct linear measurements to ± .0001″ over a range of 4″x6″, with the cross slide stage.

You save time and money by spotting inaccuracies quickly and simply. Dimensions, angles, and profiles of production-run parts can be compared directly with a *traced outline* of the projected image of the master part, or with a large scale drawing superimposed on the screen. Catalog D-27.



TOOLMAKERS' MICROSCOPE

Linear measurements to ±.0001″, and, when fitted with a protractor eyepiece, angular measurements to ± 1 minute of arc, can be made with this sturdy microscope. Operation is extremely *simple* and *fast*. Opaque and transparent objects of any contour can be measured. *Catalog* D-22.



STEREOSCOPIC WIDE FIELD MICROSCOPES

Provide clear, sharp, 3-dimensional, unreversed, magnified images. Used extensively in industry for greater speed and accuracy in small parts assembly operations, inspection of tools and finished parts, and precision machining of small parts. 15 models for many uses. *Catalog* D-15.

New PARA-PLANE GAGES

Now you can have "laboratory" accuracy of 0.000001″ in the determination of flatness and parallelism of reflecting surfaces... with production-line *simplicity* and *speed*. So simple that an unskilled operator can make measurements after a few minutes of instruction.

Two sizes of Para-Plane Gages are available: the larger (top) tests objects up to 6″ in diameter; the smaller (bottom) tests up to 3″ in diameter. *Bulletin* D-224.

WRITE for complete information on these five important optical aids designed to help you save time and money. You may be paying many times over their cost in lost time and rejects. Send your request to Bausch & Lomb Optical Company, 763-P St. Paul Street, Rochester 2, New York.

BAUSCH & LOMB
OPTICAL COMPANY · B&L · ROCHESTER 2, N.Y.

Indicate A-4-186-1

The woodpecker sits on a telephone pole
And tries very hard to tap out a hole.

Too bad he persists — his beak's much too dull,
For the pole is of steel — and he'll fracture his skull!

Some folks (like Woody) do not use their brain.
Dull taps heat the metal and break under strain!

To get high production, just follow this rule —
Keep Bath taps sharpened — like any good tool!

INSIST ON BATH TAPS . . . PROFIT BY THEIR PLUS-PERFORMANCE

Ground from the solid after hardening, Bath taps are precision cutting tools designed for accurate work and long wear. They require the same care that is given any valuable cutting tool. Occasional sharpening in the flutes as well as on the chamfer will maintain the high degree of accuracy characteristic of Bath taps. You'll get higher production and fewer rejects.

Whether you use our stock sizes or custom designed taps for special jobs, we'll be glad to send you tap sharpening data.

PLUG AND RING THREAD GAGES • GROUND THREAD TAPS • INTERNAL MICROMETERS

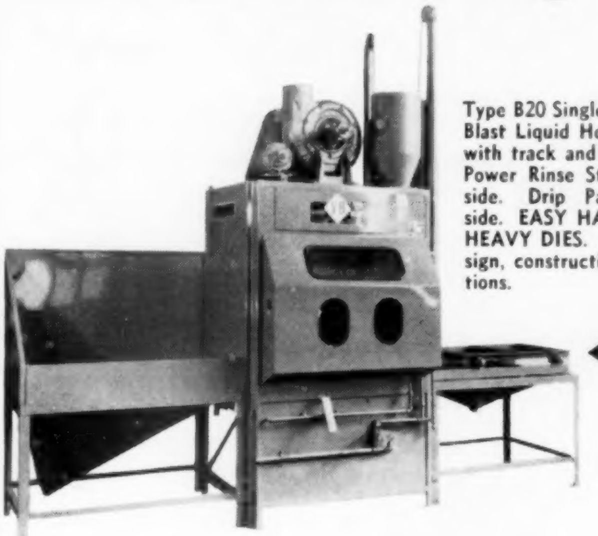
JOHN BATH CO. INCORPORATED

28 Grafton St., Worcester, Mass.

Indicate 4-187-1

VAPOR BLAST *Always* FIRST

New Model Machines For Finishing Tools and Dies



Type B20 Single 3′x4′ Vapor Blast Liquid Honing Cabinet with track and handling car. Power Rinse Station on one side. Drip Pan on other side. EASY HANDLING OF HEAVY DIES. Improved design, construction and functions.

Type B20 Single 24″ x 30″ Vapor Blast Liquid Honing Cabinet. Nothing like it in the field. Designed and built for small tool use.

On Display Booth 555 ASTE Show

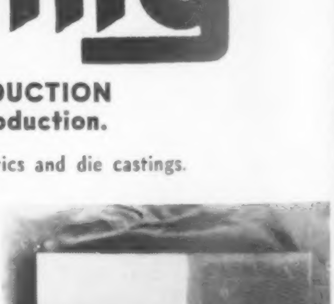
Liquid Honing

The Tool Engineer's greatest aid to improved PRODUCTION TIME SAVED—in finishing. LONGER RUNS—in production.

Widely accepted for finishing and refinishing molds and dies for glass, rubber, plastics and die castings.

Forging Die

Extruding Die



Thread Rolling Die

Unretouched photographs of actual tools before and after VAPOR BLAST LIQUID HONING. Outstanding results are obtained on dies and metal cutting tools for all types of metal processing. Our process is used for fine deburring, heat treat scale removal and final finishing of both new and reworked tools. Process demonstrating facilities, guided by years of experience and accumulated data, are at your service.

WRITE, WIRE OR PHONE TODAY FOR INFORMATION ON YOUR PROBLEM.

V-B *the* **VAPOR BLAST MFG. CO.**

3025 W. Atkinson Ave., Milwaukee 16, Wis. Telephone CUster 3-6500

Pioneers and Manufacturers

U. S. Patent Nos. 2,380,738 and No. 2,462,480 Under Exclusive License

Indicate A-4-188-1

ALL NEW "JA" FLOATING HOLDER

by SJ SCULLY-JONES

It's New And Different

A double gear spline drive coupling (unique in floating holder field) is used to give unrestricted parallel and angular float. Flexible couplings based on this mechanical principle have been in successful operation for many years in the power transmission field, to correct misalignment between shafts.

Taps Holes Accurately

Reduce rejects, increase production and profits by using the All New "JA" Floating Holder for your tapping operations.

Reams To Close Tolerances

Because of free float in all directions, under all conditions, you are assured of reamed holes being held to close tolerances.

Works On Close Centers

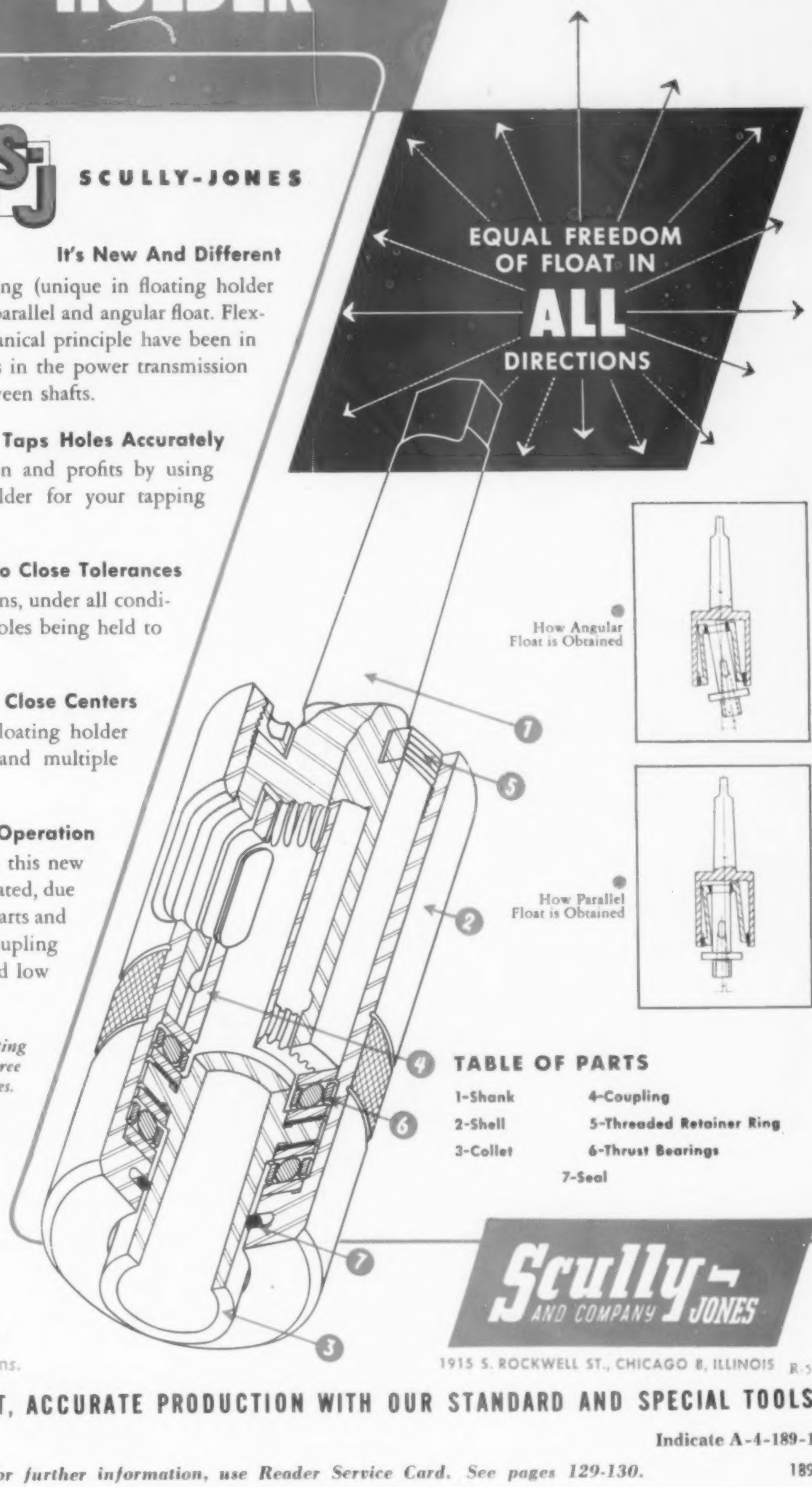
The small diameter of this new floating holder makes it ideal for close center and multiple spindle work.

Gives Trouble Free Operation

Wear on the floating elements in this new floating holder is practically eliminated, due to the positive lubrication of all parts and the large contact area of the coupling elements. This means long life and low maintenance costs.

The All New Scully-Jones "JA" Floating Holder is available from stock in three sizes with Morse Taper shanks and holes.

See the ALL New floating holder in the Scully-Jones exhibit Booth 643 at the A.S.T.E. Exhibition



How Angular Float is Obtained

How Parallel Float is Obtained

TABLE OF PARTS

1-Shank	4-Coupling
2-Shell	5-Threaded Retainer Ring
3-Collet	6-Thrust Bearings
	7-Seal

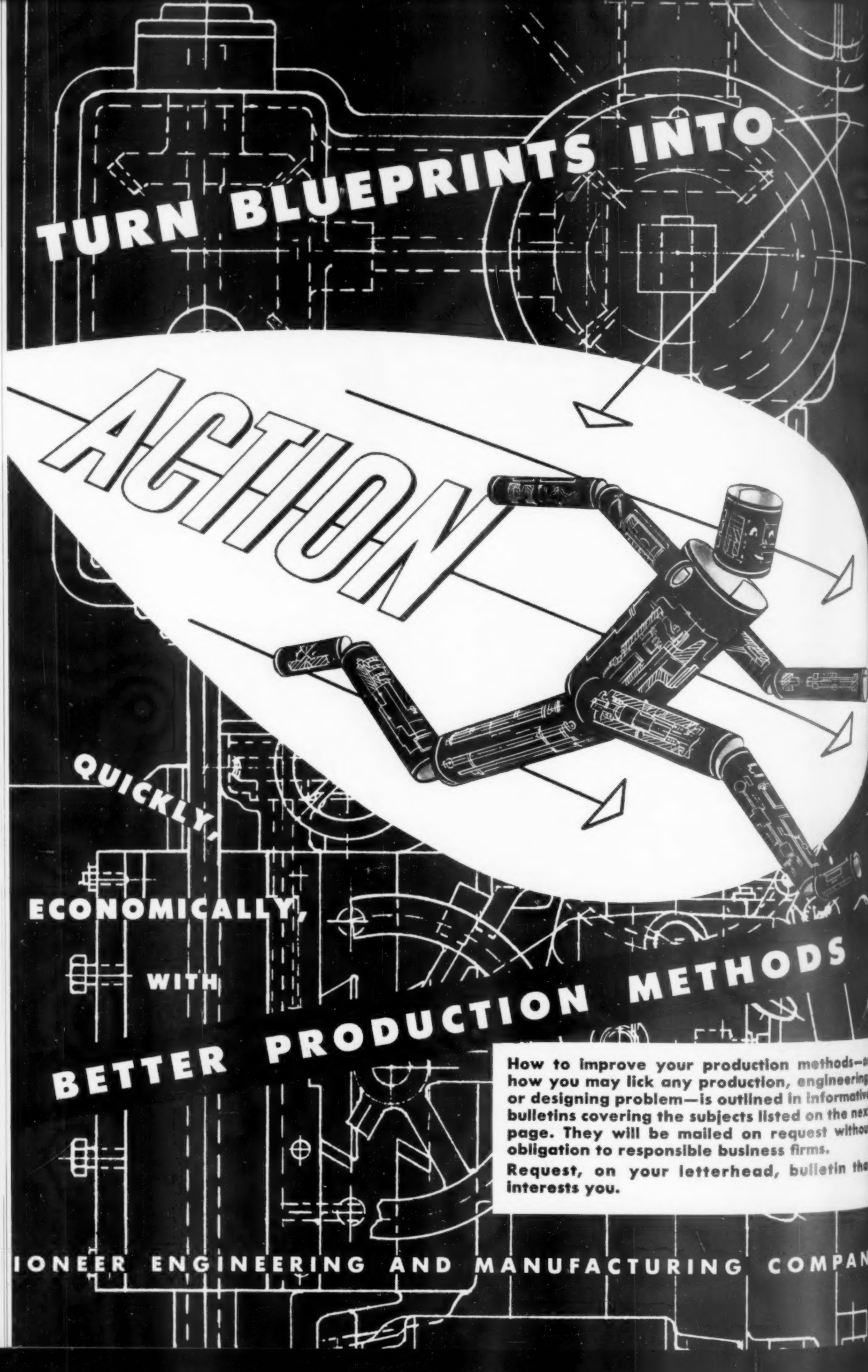
SEND FOR NEW DESCRIPTIVE BULLETIN containing [illegible] and specifications.

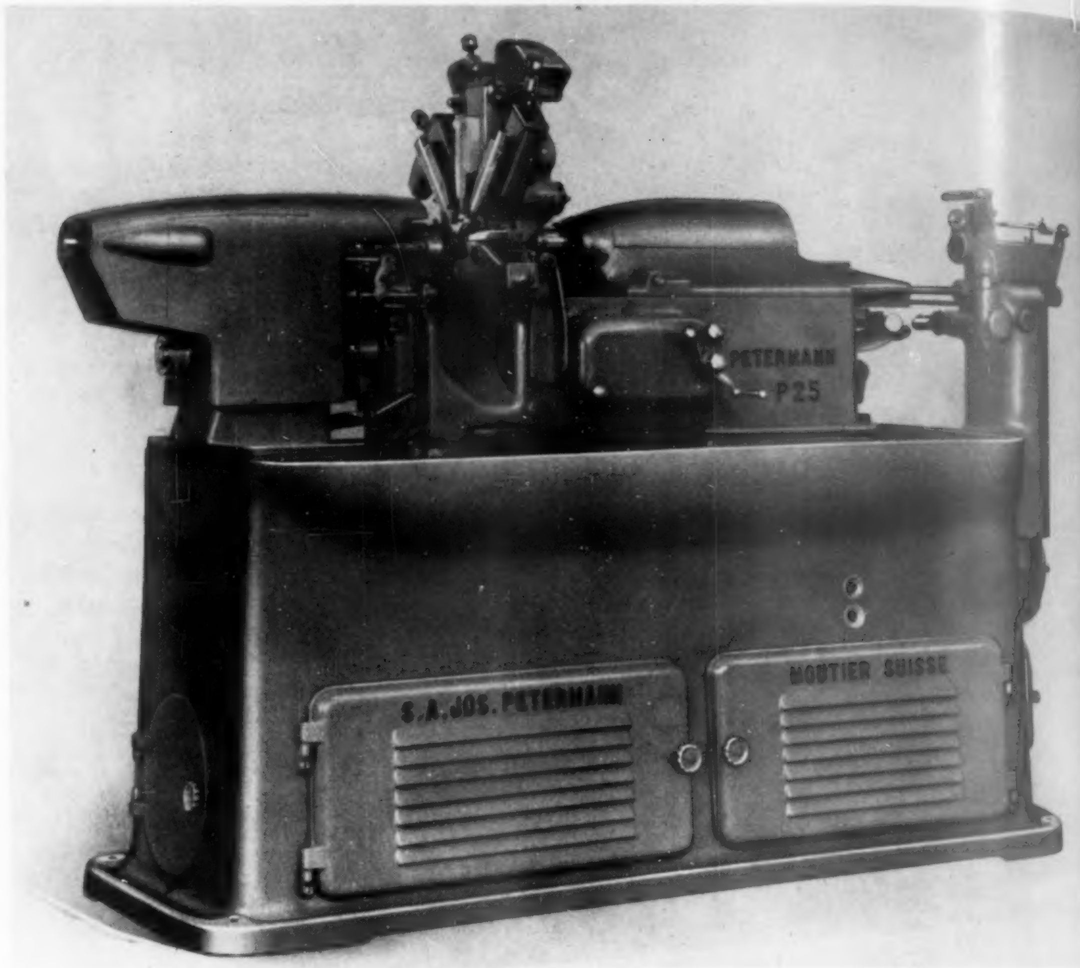
Scully-Jones AND COMPANY

1915 S. ROCKWELL ST., CHICAGO 8, ILLINOIS R-5087

YOU GET LOW COST, FAST, ACCURATE PRODUCTION WITH OUR STANDARD AND SPECIAL TOOLS

Indicate A-4-189-1


TURN BLUEPRINTS INTO
ACTION
QUICKLY,
ECONOMICALLY,
WITH
BETTER PRODUCTION METHODS
How to improve your production methods—or how you may lick any production, engineering, or designing problem—is outlined in informative bulletins covering the subjects listed on the next page. They will be mailed on request without obligation to responsible business firms.
Request, on your letterhead, bulletin that interests you.
IONEER ENGINEERING AND MANUFACTURING COMPANY



P-25 Machine with centering, drilling and threading attachment

PETERMANN

AUTOMATICS

FOR CLOSE TOLERANCES

To Be Shown in Four Sizes at the
A.S.T.E. EXPOSITION
Booth 608
PHILADELPHIA APRIL 10-14

Typical part produced on a Petermann Automatic, shown full size. Diameters held to 0.0002" tolerances

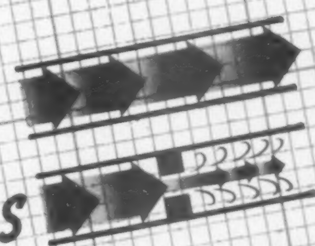
RUSSELL, HOLBROOK & HENDERSON, INC.

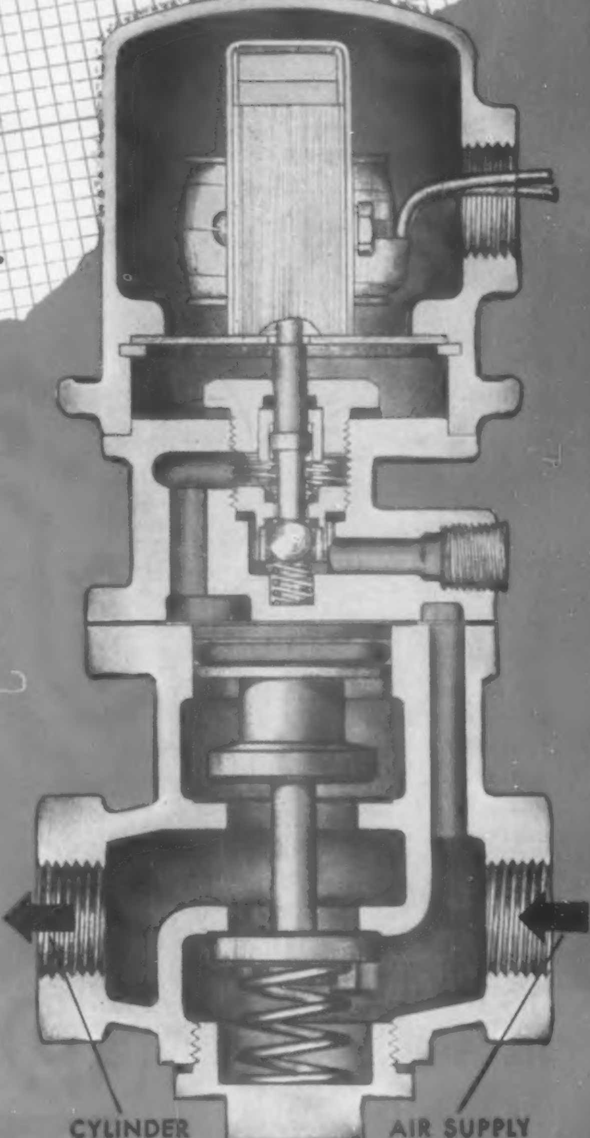
American Representatives

292 Madison Avenue New York 17, N. Y.

Indicate A-4-192-1

with Ross Full-Flo In-Line Valve you get Full Pipe Capacity!

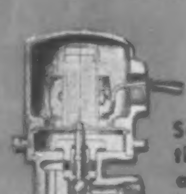




- Full Line Capacity
- Positive Seal
- High Speed Operation
- Low First Cost
- Low Operating Cost
- Low Maintenance Cost
- Over 500 Straightway and 3-Way Models in ¼"–1¼" Sizes

Ask Ross for Any Air Control Information

Ross makes valves only—hundreds of types and sizes. Take advantage of the experience gained in over a quarter century of concentration on control and application of air power!



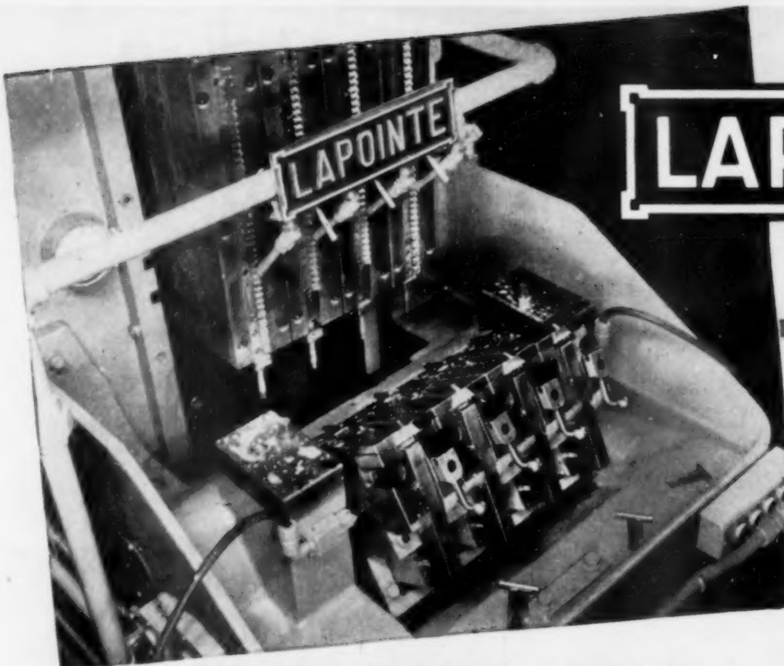
Solenoid-Pilot Sections interchangeable on all 24 Ross In-Line Bodies.

ROSS

THE BRIDLE FOR AIR HORSEPOWER

ROSS OPERATING VALVE CO.

120 E. Golden Gate Avenue, Dept. 167 • Detroit 3, Michigan



LAPOINTE
TIP-DOWN FIXTURES

...the MONEY-SAVING ANSWER
to 80% of all surface broaching installations!

TIP-DOWN FIXTURES are standard equipment on *all* Lapointe single and double ram vertical surface broaching machines, because *they offer so many important operating advantages*. Here are some of them:

TIP-DOWN Fixtures provide exceptionally easy loading and unloading, by bringing the work-holder out front *where the operator can see it and get at it.*

TIP-DOWN Fixtures do not sacrifice any of the stroke available on the machine.

TIP-DOWN Fixtures permit the use of a great variety of work holders that can be manually or hydraulically clamped.

TIP-DOWN Fixtures are constructed to permit fully adjustable work-holders to compensate for broach wear.

TIP-DOWN Fixtures are ruggedly built, having the same sturdy characteristics as the Lapointe Surface Broaching Machine.

THESE FIXTURES ARE F-A-S-T

They're so easy to load that you just *naturally* get greater production through greater speed . . . and without fatigue. You don't tie yourself into a knot, loading a Lapointe Tip-Down Fixture!

WE SUGGEST you write today for descriptive circular on Lapointe vertical broaching machines and tip-down fixtures. Ask for Bulletin DRV-TD-5.

THE *Lapointe* MACHINE TOOL COMPANY

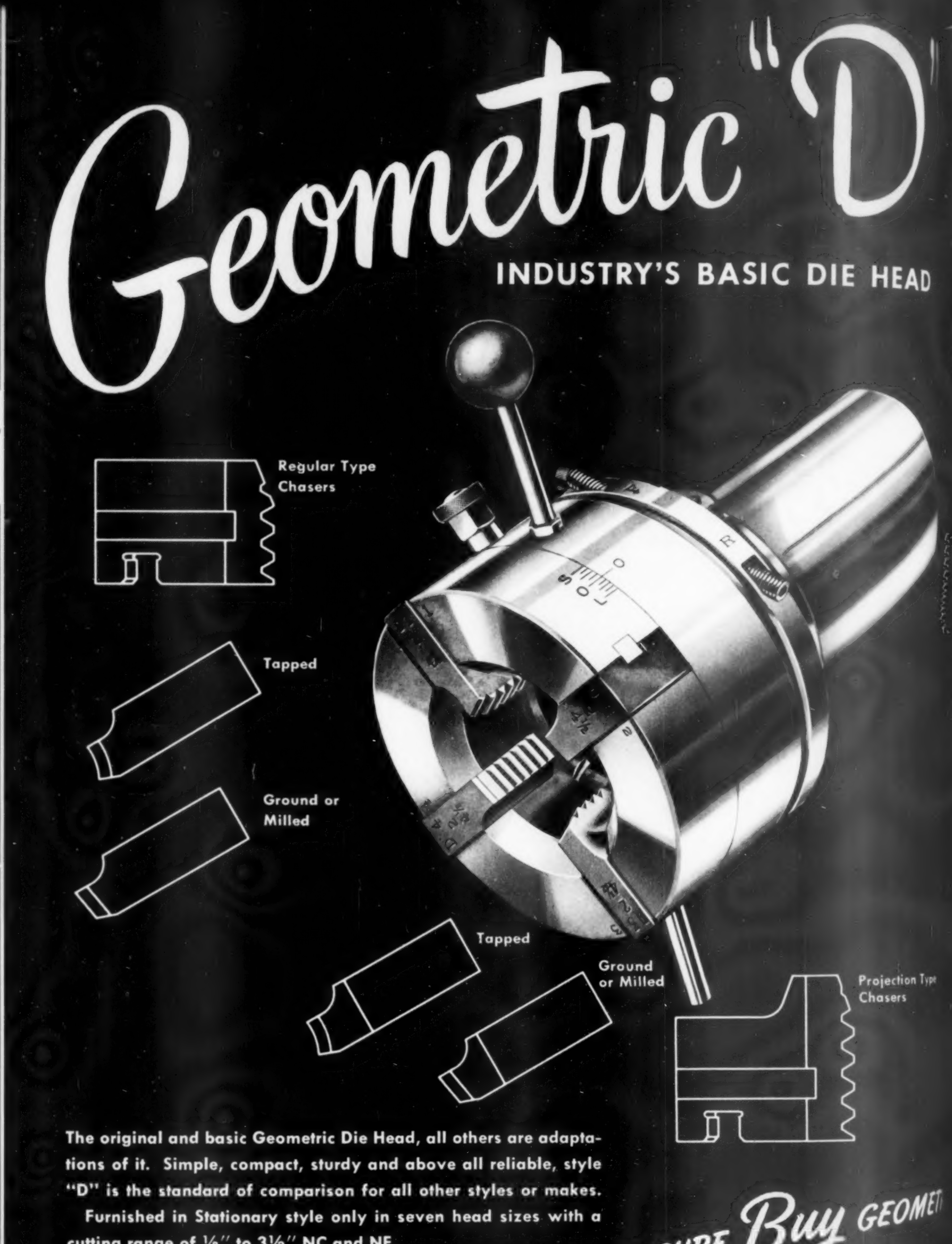
HUDSON, MASSACHUSETTS • U. S. A.

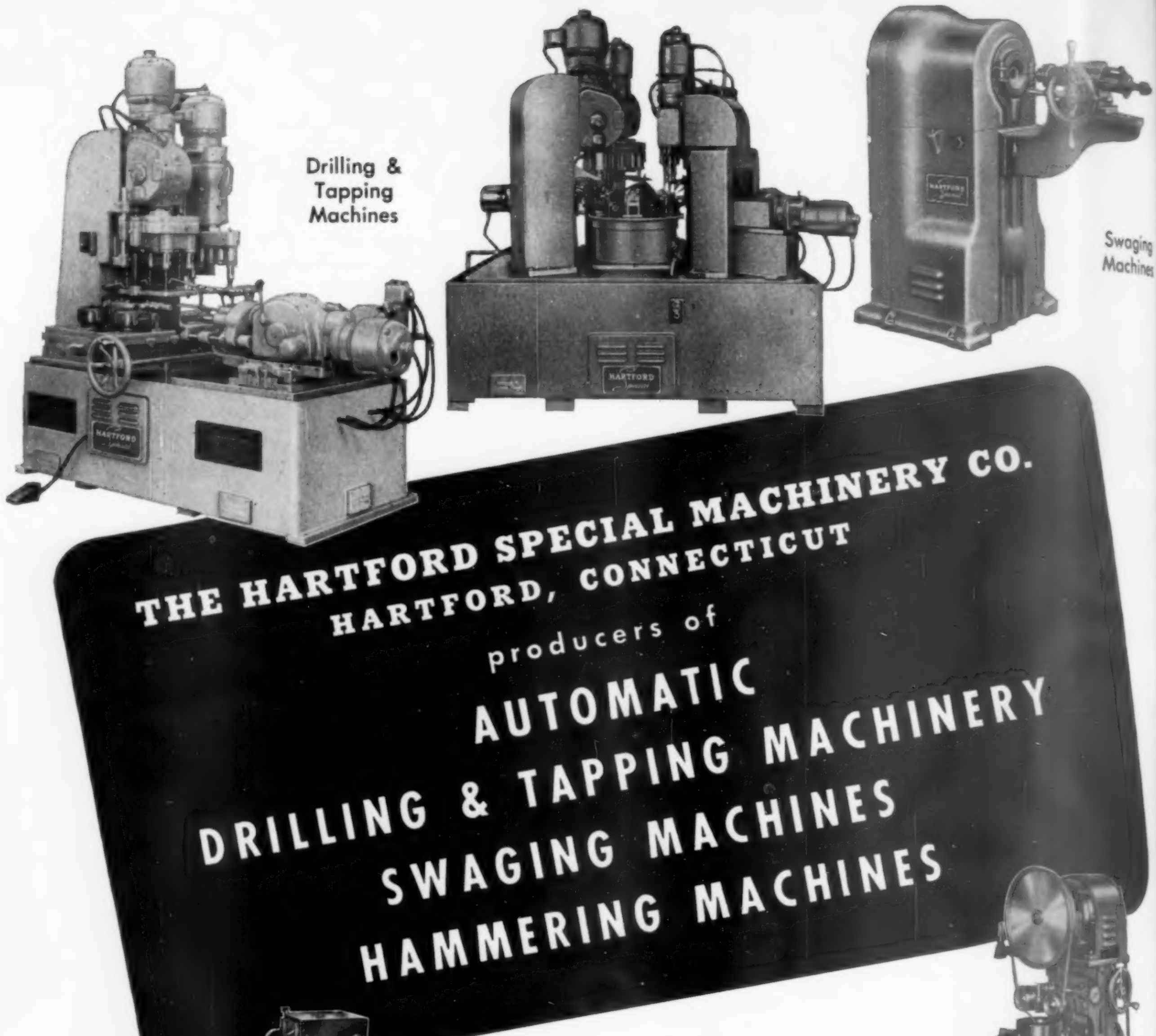
Branch Factory • Edgware • Middlesex • England

HUDSON LAPOINTE MASS.

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHES AND BROACHING MACHINES

Indicate 4-194-1


Geometric "D"
INDUSTRY'S BASIC DIE HEAD
Regular Type Chasers
Tapped
Ground or Milled
Tapped
Ground or Milled
Projection Type Chasers
The original and basic Geometric Die Head, all others are adaptations of it. Simple, compact, sturdy and above all reliable, style "D" is the standard of comparison for all other styles or makes.
Furnished in Stationary style only in seven head sizes with a cutting range of 1/8" to 3½" NC and NF.
WRITE FOR LATEST BULLETIN D
BE SURE Buy GEOMETRIC
GEOMETRIC TOOL COMPANY DIVISION
GREENFIELD TAP AND DIE CORPORATION
NEW HAVEN 15, CONNECTICUT



Indicate A-4-198-1


Here are the power blades for
EXTRA
performance
BLU-MOL DOUBLE-LIFE
HIGH SPEED MOLYBDENUM
HACK SAWS
MILLERS FALLS COMPANY, GREENFIELD, MASS. U.S.A.
HIGH SPEED WELDED EDGE
JET-EDGE
MADE IN U.S.A. BY MILLERS FALLS COMPANY GREENFIELD, MASS.
BLU-MOL®
Saves up to 50% on high speed sawing costs
Wherever hacksawing is properly supervised, Blu-Mol Double-Life blades can give the lowest cost per cut of any blade. Extremely hard teeth are cut on both edges with a differential set that allows the second edge to follow the kerf of the first without wear. Thus, one Blu-Mol Double-Life® does twice the work, yet costs less than 1/3 more than the best single-edge molybdenum blade.
JET-EDGE®
Greatest performer in machine blade history
In plant after plant from coast to coast, Millers Falls remarkable new Jet-Edge is setting production records that make seasoned shop men agree it outperforms the finest blades they've ever used. Its super high speed edge welded to an extra strong back cuts cutting costs even on the toughest work and makes this rugged, highly efficient blade unbreakable, shatterproof, definitely safer to use.
U.S. PATENT No. 2,365,301
USE THIS EDGE FIRST
No. 8884JE
18"x2"-.085-4T
No. DL 1884
21"X2"X.085"-4T
World's most complete and highly developed line of metal cutting saws
Millers Falls today offers you the greatest array of outstanding performers in the field. Unbreakable "Tuf-Flex"® and "Blu-Flex"® hand blades . . . new follow-through-type "Blu-Mol"® high speed Hole Saws . . . Metal-Cutting Bands . . . the famous "Blu-Mol Tensiometer"® . . . they'll all help you shave costs to an absolute minimum. That's why more and more companies everywhere are standardizing on Millers Falls . . . the quality line that's first with the best in metal cutting saws.
MILLERS FALLS TOOLS
SINCE 1868
Write today for a Free demonstration
on your own work in your own hacksaw machines. Just set the date, and we'll be there. No obligation, of course.
MILLERS FALLS COMPANY • GREENFIELD, MASS.

TO BE ASSURED OF "TOP" QUALITY SPECIFY MEEHANITE CASTINGS

Having developed and manufactured Shapers for more than ninety-five years, Gould & Eberhardt, Incorporated, Irvington, New Jersey, recognize the importance of selecting the right component material in translating superior engineering design into superior performance.

The production sequence from idea-to blue-print-to manufacturing procedure-to final better service in customers' plants is of special importance not only to the manufacturers of machinery and machine tools but to the users of them.

The function of castings in this sequence is particularly a vital one today and the type, quality, and engineering characteristics provided by better castings can mean the difference between outstanding leadership and quality in the field or a mediocre product.

Meehanite castings are used for the eight major parts of the Gould & Eberhardt 32″ Industrial Shaper illustrated. The internal crank mechanism comprising main lever, crank plate, and bull gear, also are Meehanite castings. The eleven Meehanite castings used in this shaper contribute the superior engineering characteristics necessary to provide in proper combination better wear, high strength, toughness, dimensional stability, rigidity, machinability, and finish.

For the complete details of the engineering properties and industrial applications of Meehanite castings, write for the Meehanite Handbook.

The castings illustrated above are produced in our foundry.

BARNETT FOUNDRY & MACHINE COMPANY
Lyons Avenue and Coit Street
Irvington, New Jersey

Also manufacturers of Ni-Resist* and Ni-Hard* castings
*Reg. U.S. Pat. Off.

Indicate A-4-201-1

For further information, see Reader Service Card. See pages 129-130

Here's a cordial invitation:

Be sure to see the

Milmaster

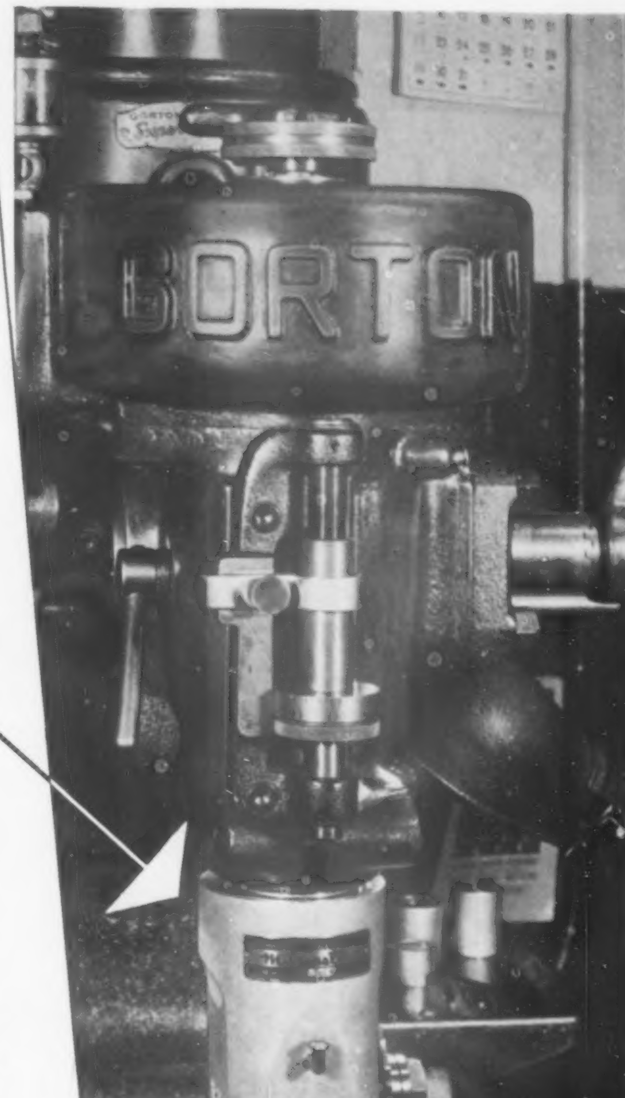
A. S. T. E. Exposition
Philadelphia—April 10-14

In Booth 1054 the Milmaster will be displayed each day of the show... attached to a milling machine and on the job. You'll see demonstrated how the Milmaster doubles milling machine capacity! How it converts a horizontal or vertical machine into a universal miller! How it cuts set-up time as much as two-thirds! How it pays for itself in a few working days.

A rugged, precision tool, the Milmaster is built by one of New England's oldest metal-working specialists. Representatives will be on hand to greet you. Remember, it's Booth 1054—and that the Milmaster slashes costs... builds profits!

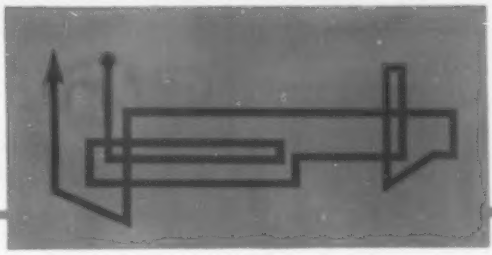
BEMIS & CALL COMPANY

SPRINGFIELD, MASS.



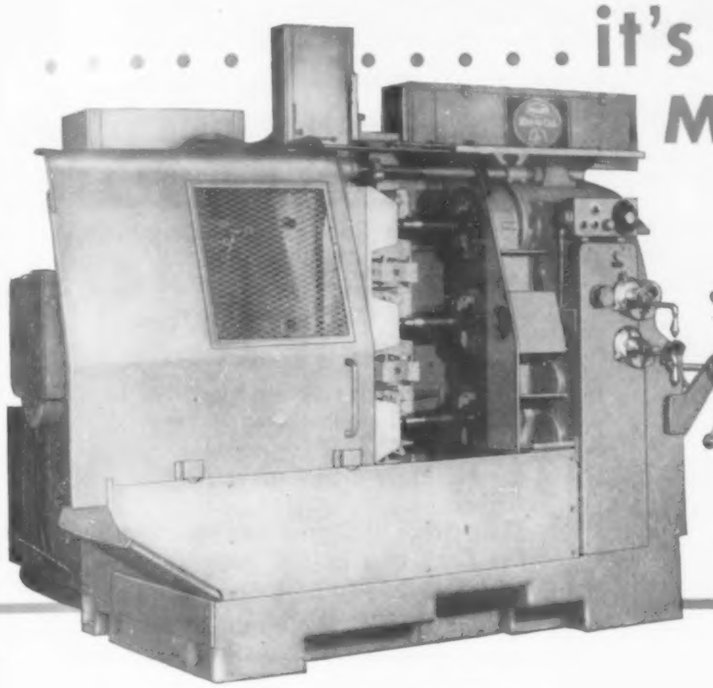
Indicate A-4-203-1

For further information, use Reader Service Card. See pages 129-130.

Follow this  Tool Path

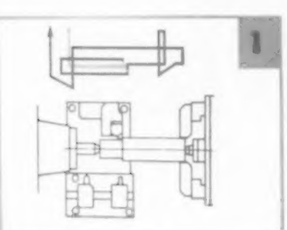
. . . . it's BULLARD

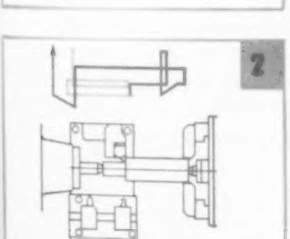
MAN-AU-TROL HORIZONTAL LATHE MODEL 30H

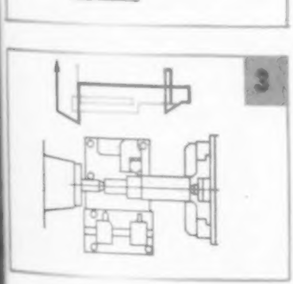


For Between Center Work On Shafts And Chucking Jobs Requiring — *Turning — Grooving — Facing — and Angular Turning.*

Fully automatic for Production runs or operated manually for short runs without disturbing the automatic setup.



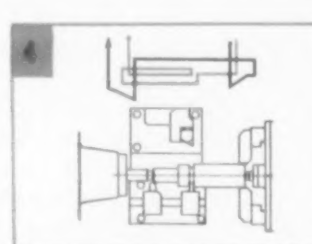


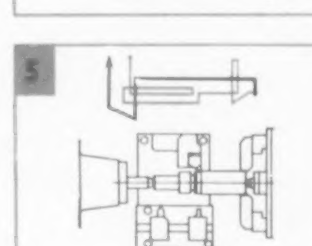


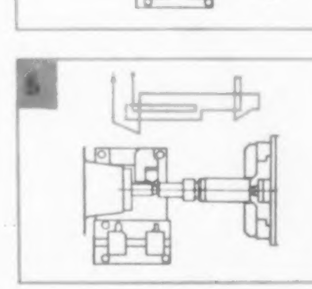
Man-Au-Trol has no predetermined sequence of operating functions, except when set for a given job. No cams are used for the movement of saddle or tool slide or for dwell at the end of a cut. Repetitive accuracy and uniformity of finished work is assured. **1.** Drive pinion Shaft SAE 3250 Bar Stock steel (size 3" x 11¾") 1st. Oper. rough turn. **2.** 2nd Oper. Finish turn to size. **3.** 3rd Oper. finish turn to size. **4.** 4th Oper. Lower tools groove and chamfer end. **5.** 5th Oper. Upper tool enters groove generates 30 degree angle and finish turns to shoulder. **6.** 6th Oper. finish face end of shaft. Production per hour 52 pieces.

16MM SOUND MOTION PICTURE

Showing the setup and operation of the Bullard 30H Lathe is available for group showing. — When writing advise your preferred date.







THE BULLARD COMPANY

BRIDGEPORT 2, CONNECTICUT

Indicate A-4-205-1

For further information, use Reader Service Card. See pages 129-130.

FOR PRECISION GRINDING AT LOW MAINTENANCE COST

Wherever Boyar-Schultz Grinders have been installed, their design, quality of materials and unexcelled workmanship are quickly recognized.

In shops where accurate, close tolerance work must be turned out, skilled mechanics turn instinctively to Boyar-Schultz Grinders, knowing that these tools give them fullest expression to their ability.

With Boyar-Schultz Grinders in your shop or tool room, you are sure you have the best your tool dollar can buy.

No. 2 PROFILE GR

You make the … Long hours of … work fitting … punches, or gr… fit quickly and … pertly with Boy… No. 2 Profile Gr…

It is a "stand… in tool rooms of … the country's … manufacturing … ments.

Made with t… dles, each indep… powered and tu… 10,000 R.P.M. w… lations. Stock re… rapid even with … small as ½" di… Both spindles … date wheels ½" … diameter.

No. 1 PROFILE GRINDER

A fast operating, precision machine tool for saving time in grinding odd and irregularly shaped surface and profiles, fitting dies and punches, grinding hardened parts in dies and punches and other time consuming jobs.

A bench model, it is large enough for many of the tool and die jobs in the average size shop.

Super-precision bearings permit the high spindle speed of 20,000 R.P.M. for rapid stock removal, even with wheels of small diameter.

No. 6-18 SURFACE GRINDER

Extreme accuracy for tool room work and grinding. Sturdy dependability for grinding i… duction. That is the best description we can … Boyar-Schultz No. 618 Surface Grinder. It … No. 2 size, 6"x18" capacity, with 6½" cross fe… table travel 20½", longitudinally only. Heav… spindle accommodates 8"x¾" wheel.

Its rugged construction and superior engi… assure constant accuracy for a longer period t… usually expected of the ordinary surface grinder.

Our new Model 6-12 Surface Grinder, a Bench … machine is now available.

No. 6-12 SURFACE GRINDER

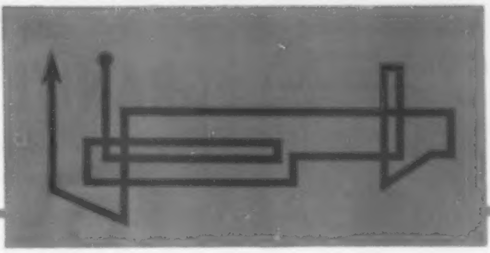
"Big machine" performance comes with this sturdy, smaller size Surface Grinder.

Designed for a high degree of accuracy, it is built to stand up day after day and deliver precision performance in any busy shop.

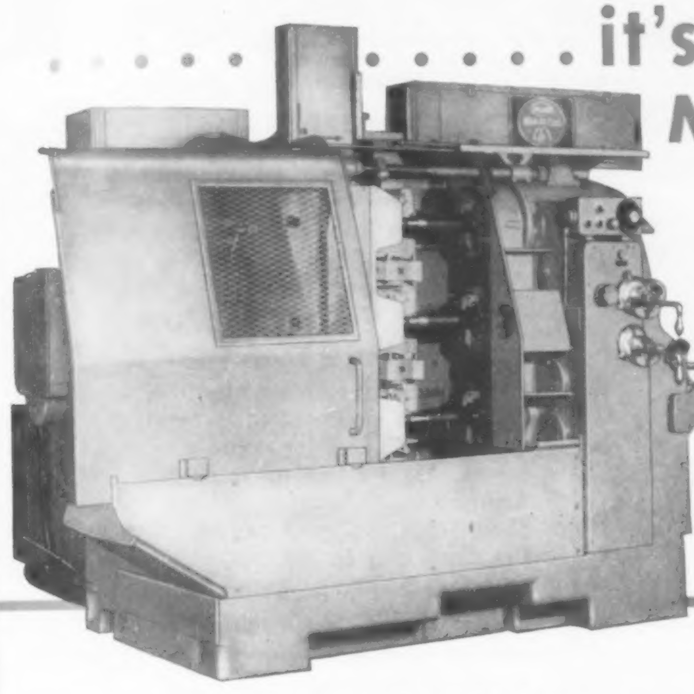
Convenient size—fits small space. Can be used as bench or floor model. Spindle has oversize, pre-loaded precision ball bearings. Rapid traverse table lever reduces fatigue. Needle bearings . . . five sets for easier action. Sturdy balanced design. Capacity for a large part of the work in the average tool and die shop. Precision usually found only in larger and more costly machines.

BOYAR-SCHULTZ CORPORATION

2107 WALNUT STREET • CHICAGO 12, ILLINOIS

Follow this  Tool Path

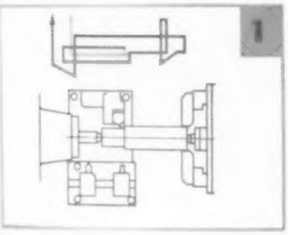
. . . . it's **BULLARD**

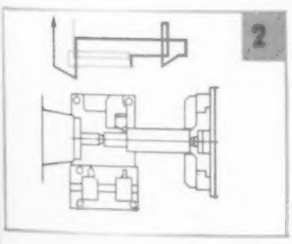


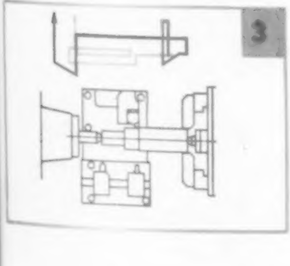
MAN-AU-TROL HORIZONTAL LATHE MODEL 30H

For Between Center Work On Shafts And Chucking Jobs Requiring — *Turning — Grooving — Facing — and Angular Turning.*

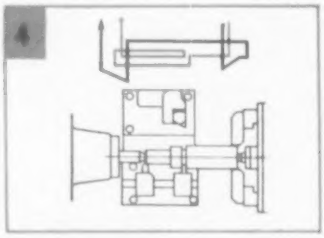
Fully automatic for Production runs or operated manually for short runs without disturbing the automatic setup.

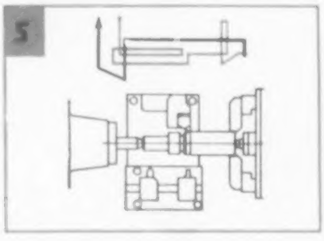


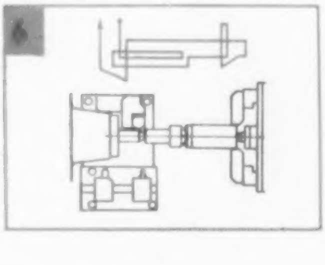




Man-Au-Trol has no predetermined sequence of operating functions, except when set for a given job. No cams are used for the movement of saddle or tool slide or for dwell at the end of a cut. Repetitive accuracy and uniformity of finished work is assured. **1.** Drive pinion Shaft SAE 3250 Bar Stock steel (size 3" x 11¾") 1st. Oper. rough turn. **2.** 2nd Oper. Finish turn to size. **3.** 3rd Oper. finish turn to size. **4.** 4th Oper. Lower tools groove and chamfer end. **5.** 5th Oper. Upper tool enters groove generates 30 degree angle and finish turns to shoulder. **6.** 6th Oper. finish face end of shaft. Production per hour 52 pieces.







16MM SOUND MOTION PICTURE

Showing the setup and operation of the Bullard 30H Lathe is available for group showing. — When writing advise your preferred date.

THE BULLARD COMPANY
BRIDGEPORT 2, CONNECTICUT

Indicate A-4-205-1

Severance CUTTING TOOLS HIGH SPEED CARBIDE

MIDGET MILLS - 1/4" Shanks

GROUND-from-the-Solid

ACTUAL SIZE

TEN LEADERS

MORE THAN 20 SHAPES--EACH IN SEVERAL SIZES

Obtain the best from the originator of GROUND-from-the-Solid

DEBURRING GROUP

30° 45° INSIDE

30° 45° OUTSIDE

HAND RADIUS

Severance JUNIOR MILLS-1/8" Shanks

GROUND-from-the-Solid

SET OF TEN

Practical for use on small grinders, for finishing Patterns, Dies, Parts, etc., in places difficult to reach with the larger Mills.

HIGH SPEED and CARBIDE

ACTUAL SIZE

Truly REVOLUTIONARY Cutting Tools

TUBING GROUP

STANDARD Chamfering

SOLID (For Radius Lip)

Severance LAB MILLS — 3/32" Shanks

GROUND from the Solid

These speedy Mills for Dental Laboratories find many uses in Jewelry and in Die and Mold making. Available in 10 popular shapes in 4 or more sizes each, for the finest cutting and finishing. May be reground up to 8 times per 1/32" reduction in diameter

ACTUAL SIZE

Write for Catalog No. 16

HIGH SPEED

Out-Perform Dental Burs and Grinding Points

COUNTERSINK GROUP

STANDARD

HEAVY DUTY

BALL SEAT REAMER

Complete REGRINDING Service — by New Tool Craftsmen — Savings are thus multiplied —

SEVERANCE TOOL INDUSTRIES, Inc.

728 Iowa Ave. Saginaw, Michigan

Indicate A-4-206-1

For Low-Cost Precision Measuring—

GRANITE SURFACE PLATES

Produced by Nature — Perfected by Herman Stone

Durable • Accurate • Economical

The inherent hardness and durability of granite, accurately finished to a guaranteed tolerance of .00005", provide the most efficient and economical surface plates for precision measurement operations. Sizes up to 8' x 16'.

★ *Non-Magnetic* ★ *Can Not Warp* ★ *Corrosion-proof*

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THE HERMAN STONE COMPANY

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PLASTIC PARTS

Can Be Made From

SHEET STOCK?

Can be formed, embossed, or DEEP DRAWN TO YOUR B/Ps much the same as sheet metal.
CRYSTAL CLEAR for lights or instrument face covers. Light diffusing: Reds, Blue, Greens and Amber.
Sheet Stock .020 thick and up, coupled with Low Die Cost, may be the answer to your problem.

T. D. SHEA CO.

7026 E. Seven Mile Rd., Detroit 34, Mich.

Indicate A-4-206-3

NUMBER ONE CHOICE IN THOUSANDS OF PLANTS

There must be a reason why GORHAM is the number one preference in thousands of industrial plants. More and more manufacturers are turning to GORHAM High Speed Steel Tool Bits for all their cutting tool needs. This superior product has won its reputation through performance . . . by meeting the most exacting requirements on tough production jobs. ★ ★ ★ Try GORHAM High Speed Steel Tool Bits in your plant today. Learn why these tools do your work better, faster, and at lower cost. Immediate delivery—place your order now.

GORHAM STANDARD for the Commercial Field

GORHAM M-40-B for Heavy Cuts in Hard Material

GORHAM GORMET for More Abrasive Materials

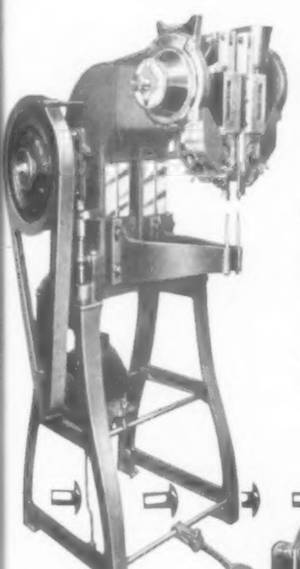
GORHAM TOOL COMPANY

14400 WOODROW WILSON AVE. • DETROIT 3, MICHIGAN

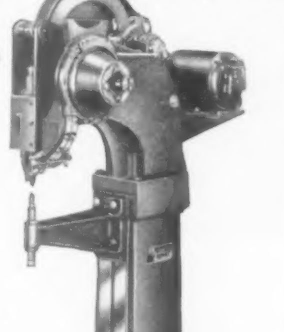
Indicate A-4-206-4

Chicago RIVET WANTS TO "*RASSLE*" WITH YOUR PRODUCTION "*TOUGHIE*"

FREE Cost-Production Study
May Crack the Problem Open
. . . Just Send a Sample of Your
Fastened Assembly or Blueprint



MODEL 214
Feeds, inserts and clinches two rivets at a time. For brass or steel tubular rivets up to 9/64" diameter. 5/8" maximum rivet length. Adjustable centers standard 3/8" to 6"; available 3/8" to 10".



MODEL 912
Sets 3/16" steel tubular rivets up to 11/16" long. 12" throat and quick change hopper (rotary type) and raceway.

On Display
Booth 1123

Chicago Rivet will go to the mat with your problem soon as you send it in. The strength of your fastened assembly, the speed of its production and its cost per unit will be thoroughly analyzed at no cost or obligation to you. The clear, concise report of this study will tell you frankly whether Chicago Automatic Riveting can help you cut costs, speed output, or stengthen your assembly, and to what extent. If it appears that Chicago Riveting can help your picture, actual production rates can often be set up from the data included in your report. Remember, this service costs you not one cent, obligates you in no way whatsoever.

Chicago **AUTOMATIC RIVETERS . . .** fasten wood to wood, metal to metal, leather to leather, composition to composition, or any combination of these materials with tubular or split rivets. Chicago riveting is faster and more efficient because up to four rivets are fed, inserted and clinched in one automatic operation.

Two modern Chicago Rivet plants at Bellwood, Illinois and Tyrone, Pa. assure prompt delivery anywhere. Your inquiry on tubular or split rivets in any rivet metals will be given prompt attention.

SEND IN YOUR SAMPLE ASSEMBLY OR BLUEPRINT NOW!

Chicago Rivet & MACHINE CO.
9619 West Jackson Blvd., Bellwood (SUBURB OF CHICAGO) Illinois
Branch Factory: TYRONE, PA.

Indicate A-4-207-1

For further information, use Reader Service Card. See pages 129-130.

COATED PRODUCTS COMMENTS

Investigation which leads to three advantages

The correct selection and application of coated abrasives can effect worthwhile reductions in unit cost, gain higher production, and improve quality. Our files contain many cases in point where an examination of methods has revealed cost-cutting opportunities through changes in the particular type of abrasive used. Or, in the adoption of a different means of application. With the technical advances which have been made in machines and materials, it becomes important to focus increased attention on improved abrasive tools, and the new ways which have been found to realize their full efficiency.

CARBORUNDUM's specialized experience in developing and fitting coated abrasives to a wide range of jobs can be of value to you in meeting changing conditions. This service is now utilized by many concerns which are noted for production efficiency. The same service is readily available to you. We welcome the opportunity of working with you toward better utilization of the best coated abrasives for your requirements. Coated Products Division, The Carborundum Company, Niagara Falls, New York.

COATED ABRASIVES BY

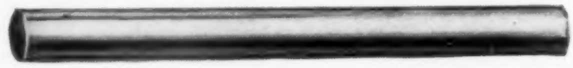
CARBORUNDUM

TRADE MARK

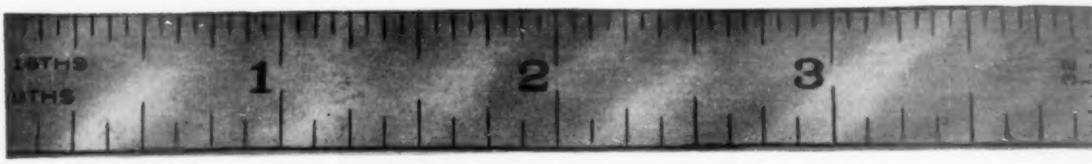
Making ALL abrasive products . . . to give you the proper ONE

"Carborundum" is a registered trademark which indicates manufacture by The Carborundum Company

Van Keuren **WIRE TYPE PLUG GAGES**



VAN KEUREN FULL 2" GAGE



AGD 1¼" GAGE

WHICH GAGE WILL YOU BUY?

CATALOG AND HANDBOOK No. 34

This 208 page volume represents 2 years of research sponsored by the Van Keuren Co.

It presents for the first time in history a simple and exact method of measuring screws and worms with wires.

It tells how to measure gears, splines and involute serrations. It is an accepted reference book for measuring problems and methods.

Copies are now free upon request.

Wire Type Plug Gages were originated by The Van Keuren Co. over 25 years ago. In 1948 this design was adopted in shorter lengths as the AGD standard for gaging holes from .030" to .510" diameter. The Van Keuren Co., because of years of pioneering, is able to offer the extra length at little or no extra cost.

You cannot afford to lose this extra length. When you need plug gages obtain a quotation from The Van Keuren Co.—Compare COST PER HOLE GAGED. You can be assured of quality and accuracy. A double inspection at the factory eliminates your inspection expense. No time will be lost waiting for replacements. You can count on prompt delivery from a stock of 2 million wires. Specify Van Keuren wire type gages and get the most GAGE for your GAGE DOLLAR.

Send for Supplement 19 showing quick and easy method of getting 4 to 10 gages from 1 VK wire type gage unit.

Booth No. 410.

Available in

TOOL STEEL **HIGH SPEED**
CHROMIUM PLATE **VK CARBOLOY**

FOR SUPERSERVICE **Phone Watertown 4-4394**

THE *Van Keuren* CO., 174 WALTHAM STREET, WATERTOWN, MASS.

31st YEAR

Light Wave Equipment • Light Wave Micrometers • Gage Blocks • Taper Insert Plug Gages • Wire Type Plug Gages • Measuring Wires • Thread Measuring Wires • Gear Measuring System • Shop Triangles • Carboloy Plug Gages • Carboloy Measuring Wires

Indicate A-4-212-1

700 HOLES REAMED

without loss of

SIZE or

QUALITY OF FINISH

Cleveland High Speed Adjustable Reamers established an excellent record on the operation pictured here—reaming blind holes 15/16" deep in SAE 3115 forgings. The specifications on this job demanded very good hole finish and size to the bottom of the hole. *Cleveland* High Speed Adjustable Reamers produced the finish that was required, and reamed an average of *more than 700 holes per grind* without loss of size or quality of finish. ◈ Moreover, the adjustable feature of these Reamers permits the blades to be reground many times and restored to the original size. ◈ If you have a reaming problem, a *Cleveland* Service Representative can help you find the best solution. Contact our nearest Stockroom, or...

Telephone Your Industrial Supply Distributor

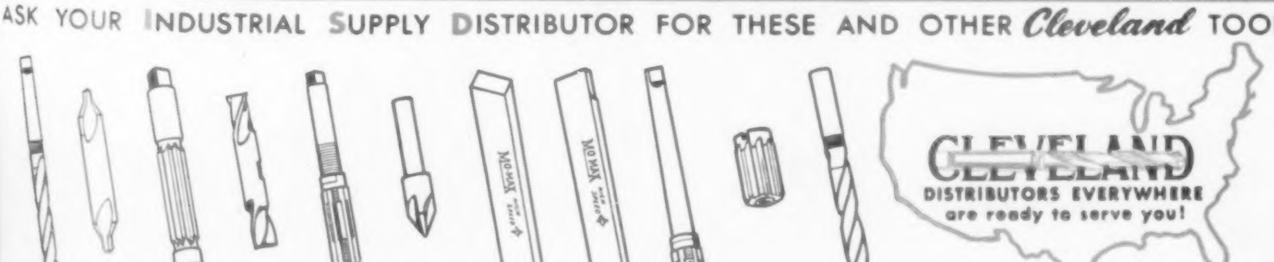
THE CLEVELAND TWIST DRILL CO.

1242 East 49th Street • Cleveland 14, Ohio

Stockrooms: New York 7 • Detroit 2 • Chicago 6 • Dallas 1 • San Francisco 5 • Los Angeles 58

E. P. Barrus, Ltd., London W. 3, England

ASK YOUR INDUSTRIAL SUPPLY DISTRIBUTOR FOR THESE AND OTHER *Cleveland* TOOLS



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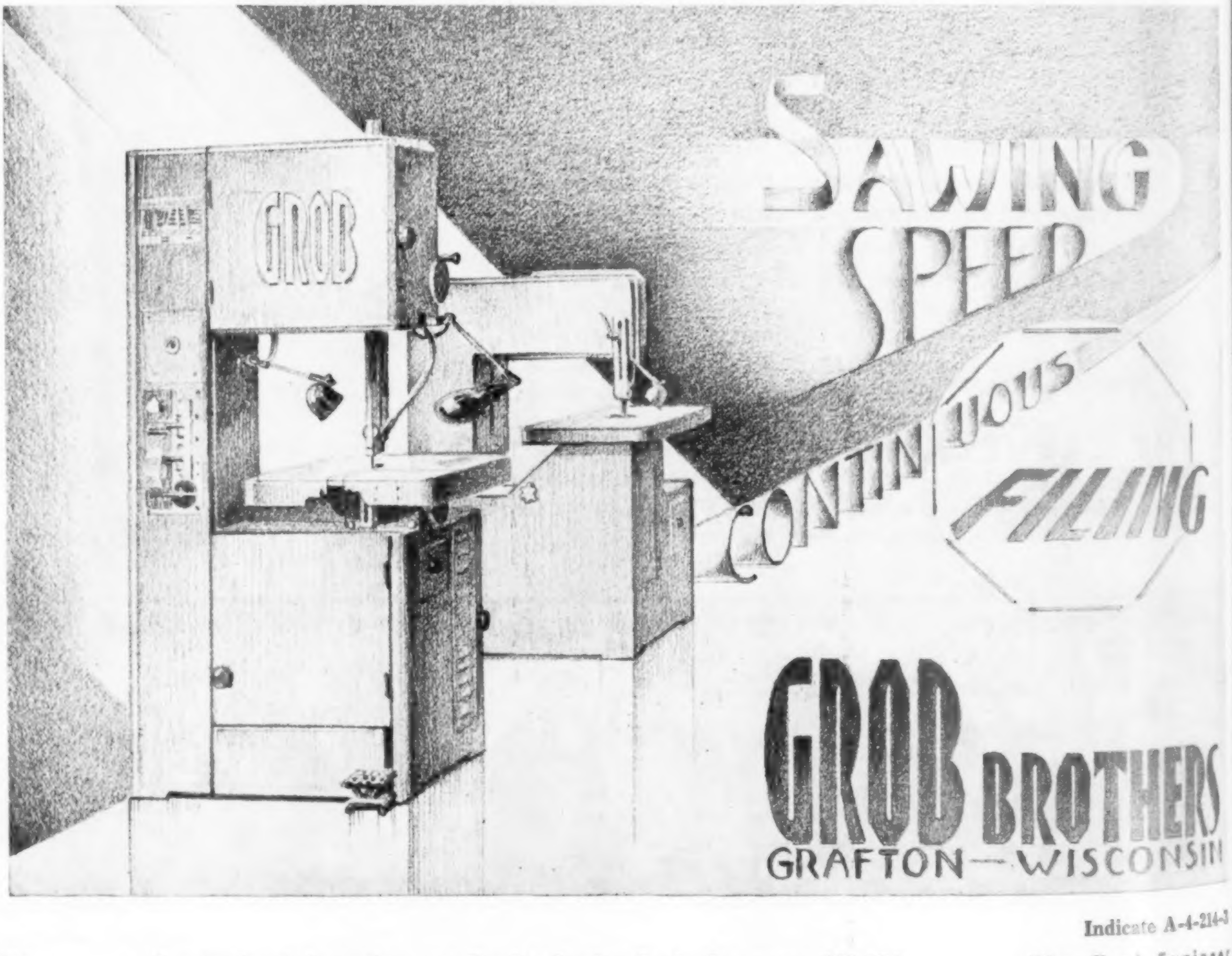
Indicate A-4-214-1

Indicate A-4-214-2



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A wide range of sizes for an ever-expanding field of applications.

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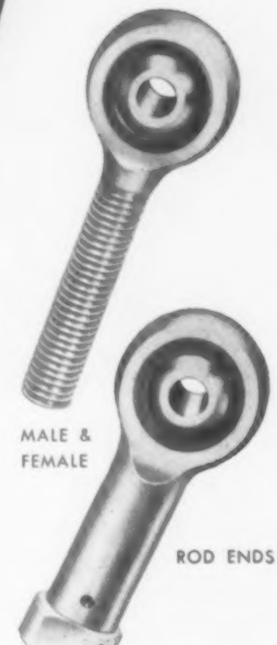
Unibal SPHERICAL BEARINGS • SPHERICAL BEARING ROD ENDS • ROLLER BEARINGS SELF ALIGNING BALL BEARINGS • PILLOW BLOCKS • ROLLER BEARING AND BALL BEARING FLANGE UNITS.

UNIBAL SPHERICAL BEARING



MALE & FEMALE

ROD ENDS

You are invited to visit

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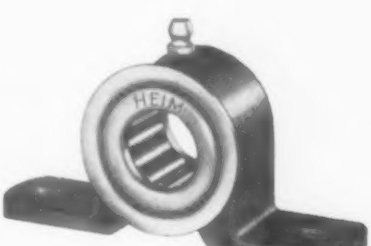
FLANGED ROLLER BEARING

There is a HEIM bearing to meet YOUR require-ments.

Please write for complete catalog

FLANGED BALL BEARING



BALL & ROLLER BEARING PILLOW BLOCKS

BALL & ROLLER BEARING FLANGE UNIT

CAST IRON BODY PILLOW BLOCKS

HEIM

THE HEIM COMPANY

FAIRFIELD, CONNECTICUT

Indicate A-4-215-1

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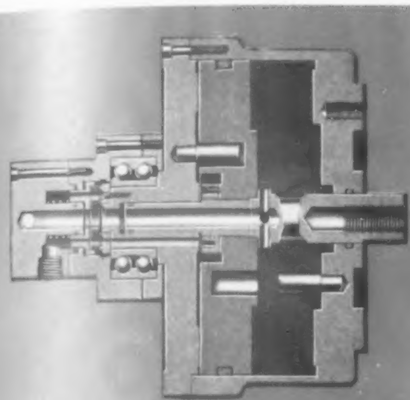
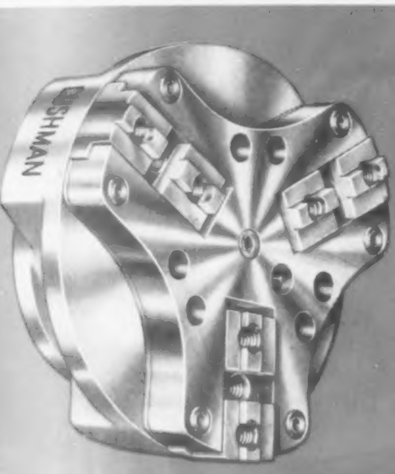
For further information, use Reader Service Card. See pages 129-130.

RAISE your speed limits

and LOWER your costs



CUSHMAN
High speed
ALUMINUM BODY
AIR CYLINDERS



CUSHMAN
High speed
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AIR CHUCKS

50% weight reduction to reduce WR^2.

Quick stops and starts, less wear on clutches . . . brakes.

Precision-ground hardened steel jaws, jaw bearings and faces.

All moving parts hardened and fitted to hardened steel bearing surfaces.

Faces aligned for precision attachment of fixtures, etc.

Wedge action jaw movement counteracts centrifugal effect.

Statically balanced to eliminate vibration.

MATCHED TO PERFORM CONSISTENTLY

AT SPINDLE SPEEDS UP TO 6000 r.p.m.

This, we believe, is the first time that a matched, balanced and standardized combination of aluminum body rotating air cylinders and air chucks has been made available for safe day-in, day-out operation at such speeds.

Engineers will at once recognize the problems that had to be solved . . . the tremendously increased influence of centrifugal forces and the necessity for reducing weight and flywheel effect while at the same time maintaining rigidity, jaw grip, and accuracy of centering. Cushman has solved these problems and the Chucks and air cylinders are now available to meet a wide range of tooling applications. Possible cost savings with this type of equipment on new high speed machine tools are substantial enough to warrant your immediate investigation. Write us outlining your operation.

CUSHMAN

Visit Cushman Booth #866
ASTE Industrial Exposition
Philadelphia, April 10-14, 1950

THE CUSHMAN CHUCK CO.
HARTFORD 2, CONN.

Indicate A-4-217-1

For further information, use Reader Service Card. See pages 129-130.

TO THE NEW 20" LeBLOND HOLLOW SPINDLE LATHE

This newest addition to the LeBlond line will qualify for the blue ribbon in the oil country, the steel industry—and any other spot where a 9" opening through spindle, a 27" swing capacity, and an 18-speed geared headstock arranged for 15-hp main drive motor are required. The 20" Hollow Spindle—fourth in a line already including 16", 27" and 30" sizes—will win your approval because it combines simple, economical operation with precision results.

★ SIX MARKS OF MERIT

- Quiet, powerful headstock with 18 geared speed changes.
- Electric Brake with apron spindle start, stop and reverse control.
- Quick-change box offering 63 feed and thread changes.
- Hardened and ground steel bed ways front and rear.
- One-piece apron with positive jaw feed clutch.
- Thrust-lock tailstock.

GET YOUR COPY
of bulletin HS-111 describing the new 20" LeBlond Hollow Spindle Lathe.

THE R. K. LeBLOND MACHINE TOOL COMPANY, CINCINNATI 8, OHIO
LARGEST MANUFACTURER OF A COMPLETE LINE OF LATHES.
SALES OFFICES: New York, Chicago, Detroit.

LeBLOND

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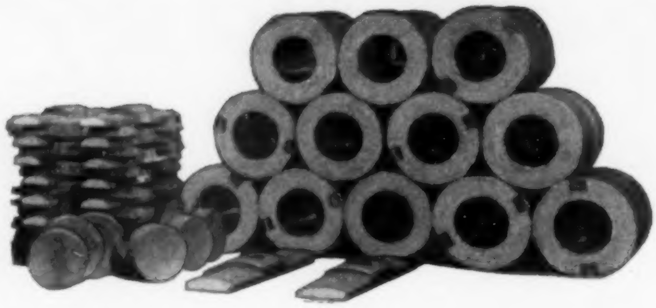
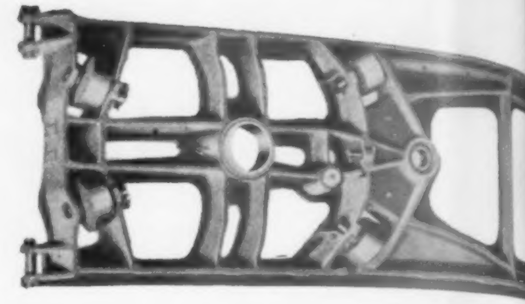
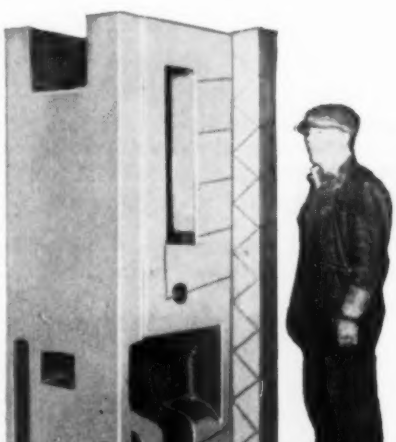


Rolling Mill . . . Screw-down Nuts — Ampco alloys are selected for their high resistance to terrific pressures and impact. Rolling mill pressures are transferred through the screw to the nut threads. In cases such as a blooming mill, this pressure is applied with impact — increasing from zero to several million pounds in a fraction of a second. That's why they need the tough strength of centrifugally cast Ampco aluminum bronze.

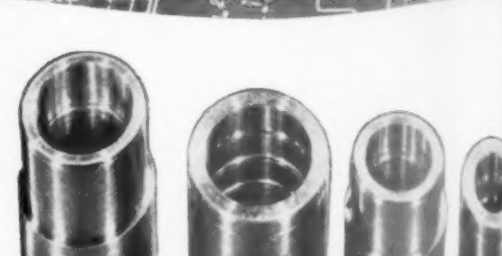


Earth-moving Equipment . . . Excavator R
Bushings — Ampco Grade 16 selected for unusual wear r ance, excellent bearing qualities and high load-bearing st Turntable roller bushings must carry the tremendous weight o cab, boom, and load. The turning is slow but eccentric becau the cantilever action of the boom and load. Ampco bronze also used for gears, plates, cams, sleeves, and many other ant excavator parts.

Garden Tractors . . . Worm Gears — Ampcoloy E-123 aluminum bronze selected for high strength and wear resistance, high impact and fatigue values. Reduced replacements to a mere 1/10 of the previous average. This outstanding saving is typical, accounts for the specification of Ampco aluminum bronzes for a wide variety of gears—from tiny fishing-reel gears to giant 1-ton gears for rolling mills.



Forging Machinery Upsetter Slides — Ampco Grades 18 and 20 selected by one manufacturer to replace hardened steel because they combine excellent bearing qualities with the necessary strength to withstand a 40,000 psi load. In two and a half years of service they showed little signs of wear. The same high physical properties make these alloys ideally suited for such applications as wear strips and wear plates.



Die Sets . . . Guide Pin Bushings — Ampco Grade 18 selected for its hardness and excellent bearing qualities. Seizing and galling are eliminated. Exceptional resistance to wear maintains tolerances. Correct alignment is assured regardless of speed of travel. Tests by one concern show Ampco guide pin bushings give 2½ times the life of previous material. Standard bushings are centrifugally-cast from Grade 18 Ampco Metal.

64 MANHOURS saved on this one job!

The precision aircraft forging shown here had 17 angles, of which 9 were compound angles. Checking by the sine bar method required two men working a total of

96 HOURS ➡

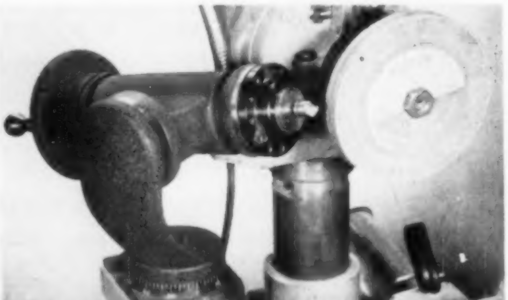
Checking the same part with a Studler Angle Computer required only one man working

32 HOURS ➡

—a saving of 64 manhours per forging, plus savings of material which would have been wasted! Speed up *your* production with the Studler Angle Computer Write
THE ANGLE COMPUTER CO.
1709 Standard Avenue • Glendale 1 Calif.

STUDLER ANGLE COMPUTER

SPEED UP TOOL GRINDING OPERATIONS with the NEW, IMPROVED I-G-C RELIEF GRINDER



The new, improved I-G-C RELIEF GRINDER, Model 100-B handles with equal speed and accuracy countersinks, center drills, integral pilot cutters and pilot drills, either right or left hand. Redesigned so that the working head can be set at any desired position, it speeds up all types of cutter grinding operations by as much as 300%. Actual tests have proved that the I-G-C will pay for itself over and over in time and labor savings.
The I-G-C RELIEF GRINDER can be used with equal success for any type of small tool cutter grinding, such as the sharpening of end mills, shell end mills, spot facers, small milling cutters, machine reamers and also the backing-off of thread taps.
For further information and descriptive literature on all models of the above products, kindly wire or write

The Angle Computer Division
S & D ENGINEERING COMPANY
1709 Standard Ave. Glendale 1, Calif.

Indicate A-4-222-1

Machine MULTIPLE DIAMETERS— *in* ONE OPERATION *with* SUBLAND TOOLS *and Cut Production Costs*

As an example: the tool pictured at left, above, reams and counterbores a 1.375 hole, forms a radius and reams a 1.750 hole *all in one operation* —plus the economy of easy resharpening and extended tool life available with subland design. Check and see if a subland tool, designed and built under Fuller supervision, will not cut production costs for you.

"BETTER" if it's made by FULLER!

SKILLED CRAFTSMEN

FULLER TOOL Co.

SPECIAL TOOLS • PRECISION MACHINING
GUILD
3956 WEST ELEVEN MILE ROAD
BERKLEY • MICHIGAN
Telephone LINCOLN 2-5600

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GEORGE L. Detterbeck Quality Tools
SPEED UP Screw Machine Production

SELECT YOUR NEEDS FROM THIS LIST

We specialize in
- CUTTING CAMS
- HIGH SPEED STEEL AND CARBIDE FORM TOOLS
- SPECIAL CUTTING TOOLS
- SPLIT DRILL BUSHINGS
- CROSS SLIDE KNURL HOLDERS
- TOOL BITS
- BOX TOOLS
- BURNISHING TOOLS
- REVOLVING STOPS
- SKIVING TOOL HOLDERS
- THREAD ROLL HOLDERS
- RECESS SWING TOOLS
- FORMING SWING TOOLS

Inasmuch as we manufacture cams and tools for the trade we obviously do so on a production basis. As a result we offer:

1. Superior type tools . . . at low cost.
2. Practical design based upon many years of experience.
3. Correct specifications which insures maximum service.

Your tool requirements in our hands is your guarantee of better tools at a great saving.

PROMPT DELIVERIES

Tool making with us is a routine matter. Special equipment . . . skilled hands . . . plus know how, enables us to fill orders in a minimum of time.

COMPLETE ENGINEERING SERVICE

Let us quote on your tool requirements. You'll save money . . . even as compared with "home made" tools. Standard circular form tools for B&S and Davenport Machines carried in stock. Immediate delivery.

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ENGINEERS TO AN INDUSTRY

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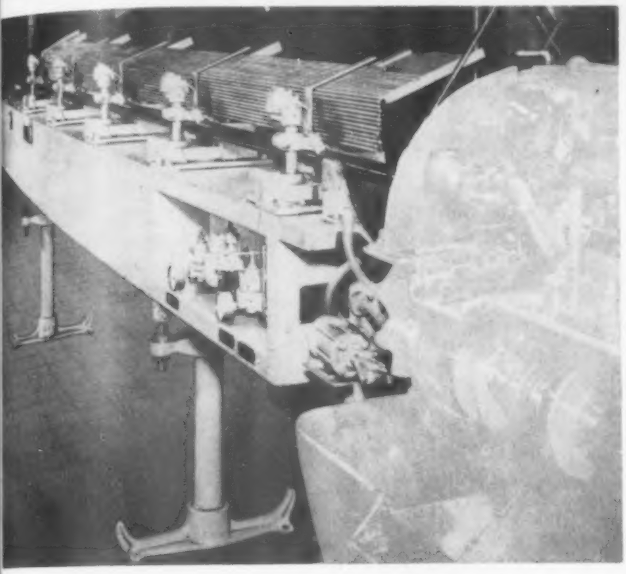
MAGAZINE LOADING PNEUMATIC BAR FEEDS

Increase Screw Machine Output Up To 60% or More



MODEL AML BAR FEEDS FOR B & S SCREW MACHINES HANDLE FULL CAPACITY OF ANY MACHINES TO WHICH BAR FEED IS ATTACHED.

(Model Determined by Spindle Bore of Machine)

Model		
AML 56	for B & S No. 00	Spindle Bore 3/16"
AML 68	for B & S No. 00	Spindle Bore 11/16"
AML 87	for B & S No. 0	Spindle Bore 7/8"
AML 100	for B & S No. 0	Spindle Bore 1"

Restocking time replacing bar in spindle	4 sec.
Time to load magazine per bar (2 to 3 mins. for full magazine)	1/2 to 1 sec.
Piece length per one feed-out or collet opening	0" to 16"
Stock capacity (dia.) #0 B & S (approximately)	3/16 to 5/8" dia.
Stock capacity (dia.) #00 B & S (approximately)	1/8" to 1/2" dia.
Magazine capacity	19 - 5/8" bars 96 - 1/8" bars
Time per one feed-out or collet opening	.2 to .5 sec.
Feed cylinder air pressure	18# to 35# P.S.I.
Installation time	6 hrs. to 8 hrs.
Set-up time, bar feed unit only	5 min. to 15 min.
Number of machines per operator	Up to 8 or 10

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Every Day
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Typical Jobs

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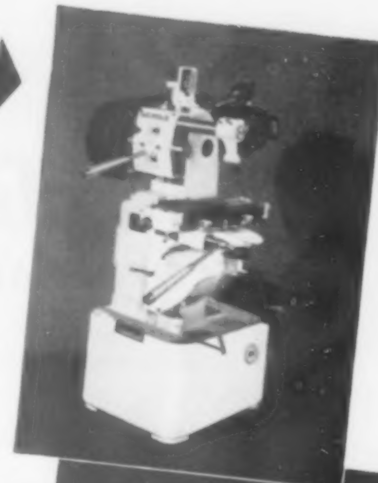
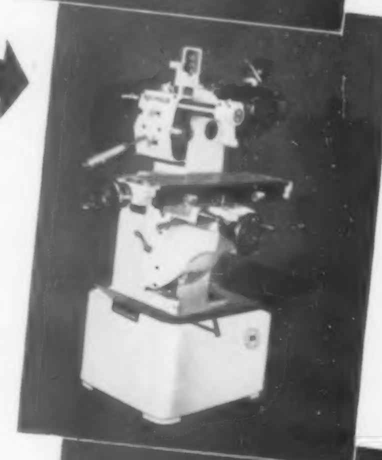
Nichols MILLERS - - - the millers that use their heads

Nichols STANDARD MODEL



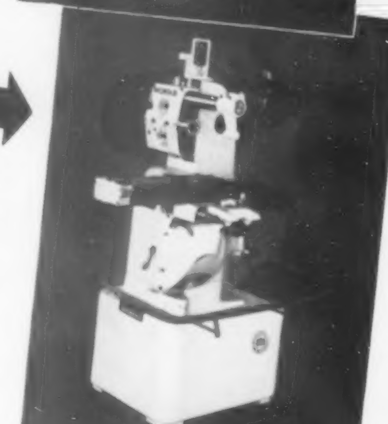
Nichols Millers are built to the highest standards of precision so that tool room, laboratory, or production work may be produced to tolerances "in tenths." The Standard Nichols Miller is a manually operated horizontal type machine. It combines with all the conventional movements of table, saddle and knee a rise and fall spindle which allows the cutter to be brought to the work. This flexibility makes possible operations such as broaching, key seating and contour milling as well as regular milling.

Nichols TOOL ROOM MODEL



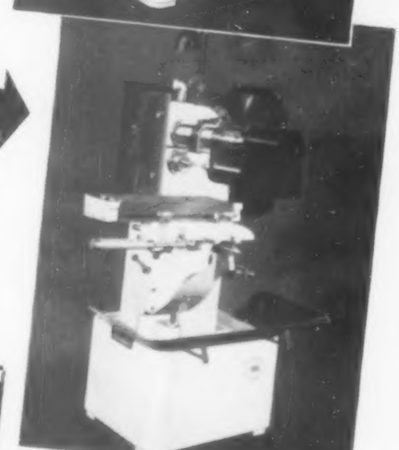
The Tool Room Model is a standard Nichols Miller, equipped with a special table assembly providing greater working surface and increased longitudinal feed. Both longitudinal and transverse feed screws are fitted with hand wheels and extra large adjustable micrometer dials having easily read machine-engraved graduations. This machine is especially valuable in the tool room because of its compactness, generous capacity and ability to turn out a wide variety of extremely accurate work.

Nichols AIR FEED MODEL



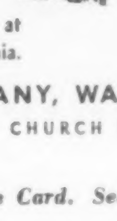
The Standard Nichols Miller equipped with pneumatic table feed substantially increases its value as a production machine. The power feed, which operates on 75–175 psi is entirely automatic — the operator merely has to load and unload pieces and can with ease run two or more millers. Thus, output can be multiplied to a mass production scale while tolerances are held to "tenths."

Nichols DOUBLE SPINDLE MODELS



Two Spindle Millers are most valuable for long production runs where simultaneous action of two cutters is practical. Two basic double spindle models are made, one with two identical spindles, and the other with two opposed spindles. These millers, available with hand or power feed, will be built or modified to suit the individual user's requirements.

For complete details and information write for the booklet, "The Miller that Uses Its Head".



See these machines, plus the full line of NICHOLS MILLERS at the A.S.T.E. SHOW, Booth 931, April 10-14, 1950, in Philadelphia.

ni

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Gerotor meets this requirement with equipment designed by foremost engineers in the air field. Compactness of 4-way valves prevents fouling or leaking; large, convenient pipe connections allow unrestricted air flow. Cylinders, notable for absence of tie rods, have Keeper ring design, permitting compact installation.

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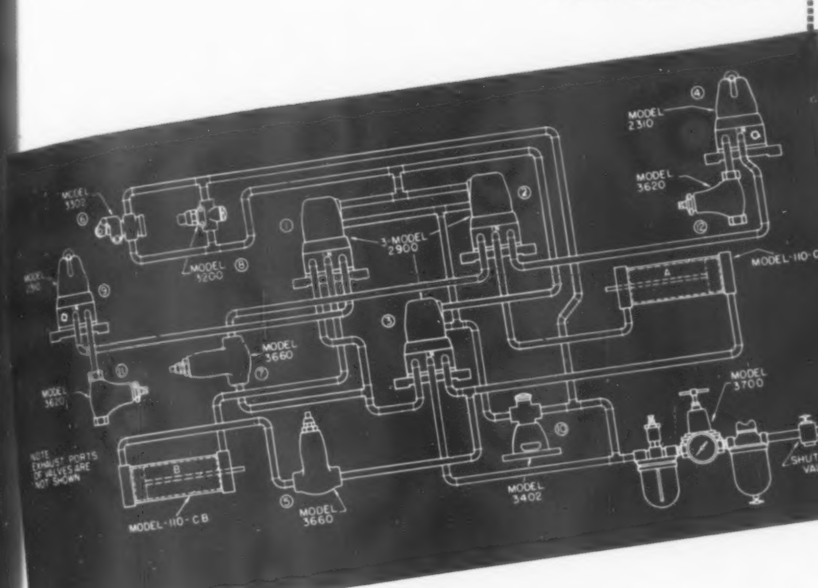
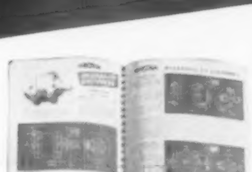


AIR EQUIPMENT ON AN AUTOMATIC LATHE FOR CLAMP, TURNING AND CUT-OFF

● Depressing pedal of (10) pilot valve exerts pressure on pilot end of (1), (2) and (3) pilot operated 4-way valves. Air flows from valve (3) to blind end of clamp cylinder (A). Piston moves out rapidly, the air from rod end being exhausted thru (4) cam operated 4-way valve. When clamp cylinder rod (A) depresses cam of valve (4), exhaust air from cylinder is restricted (12), providing for a slow approach. When clamp cylinder engages work, pressure in supply line increases, causing sequence valve (5) to open. Air flows into blind end of cut-off tool cylinder (B) and a similar action takes place thru the out-stroke, by means of (9) and (11). After the cut-off, cylinder rod depresses cam of (6) pilot valve which, by pilot pressure, reverses valves (1), (2), and (3). Air line is then connected to the rod end of cylinder (B) and retracts cut-off tool. After cylinder completes return stroke, pressure builds up in supply line connected to sequence valve (7). Pressure opens valve (7) and allows air to rod end of clamp cylinder. After it retracts, cycle is completed. Pilot valve (8) permits interruption of cycle to retract cylinders.



Get Gerotor Catalog Sections No. 54 and No. 302

describing air valves and cylinders

Write to

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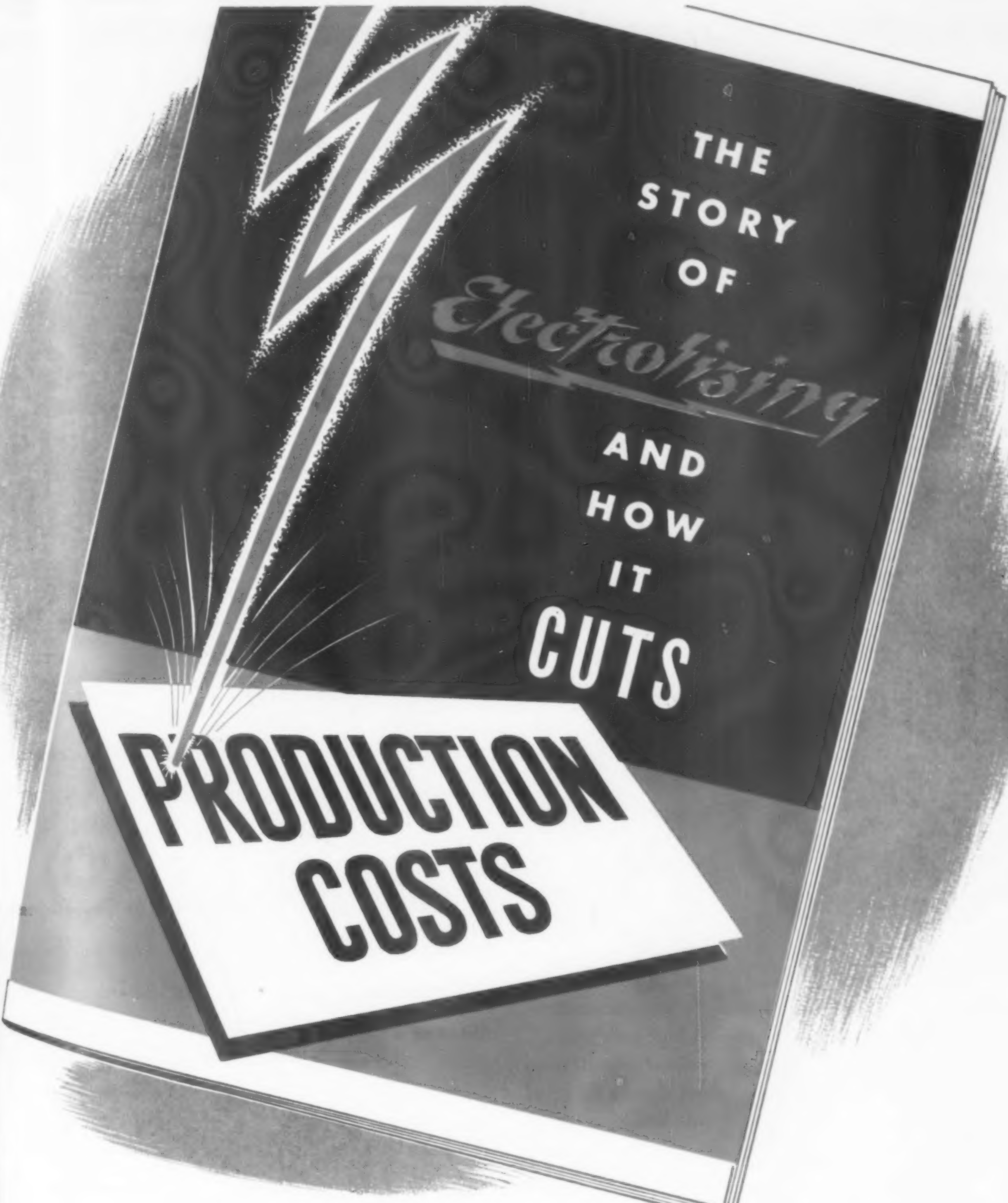

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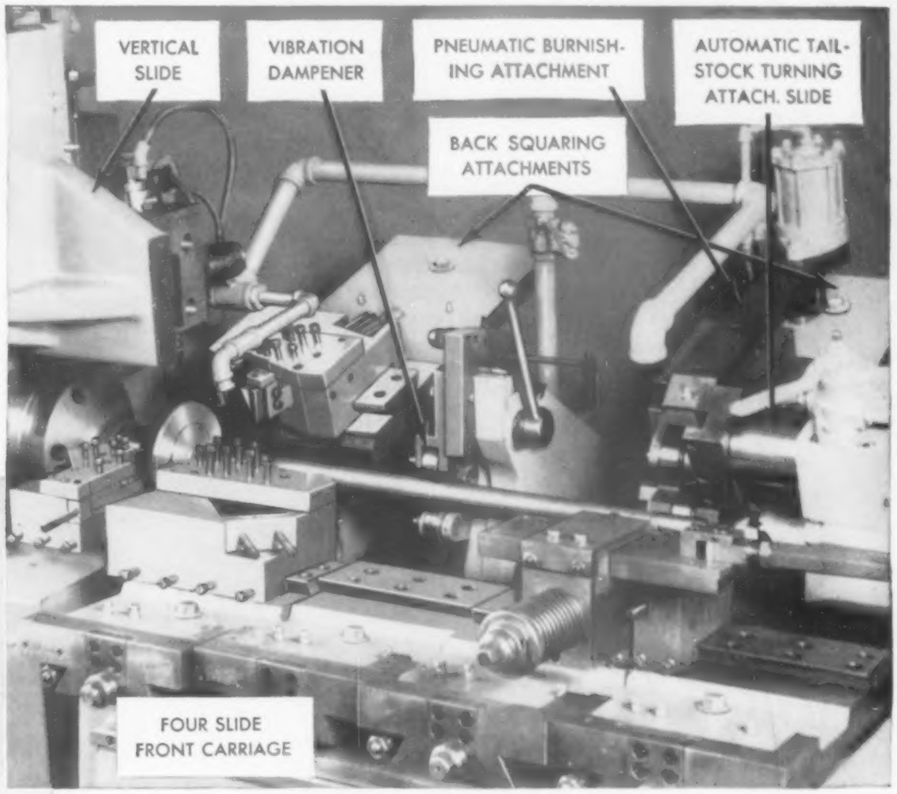
ACHINE OF THE MONTH

RED BY THE SENECA FALLS MACHINE CO. "THE Lo-swing PEOPLE" SENECA FALLS, NEW YORK

DEL AR Lo-swing ATHE ROUGH AND INISH TURNS AXLE SHAFTS IN ONE ERATION AT HIGH RODUCTION RATE



em: To rough and finish turn axle shafts with ts on flange faces and splined end, and to burn- seal diameter.

on: The Model AR Lo-swing Lathe selected for b was equipped with a four slide front carriage, tomatic back squaring attachments, a vertical slide mounted on the headstock and an auto- ailstock turning attachment.

afts are delivered to the Lo-swing Lathe with ntered and with two shallow driving pin holes in the flange. After mounting the shaft between , a spring operated "Vibration Dampener" is inst the rough forged shaft to eliminate whip and vibration at high cutting speeds.

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Let Seneca Falls engineers assist you with your turning problems.

SENECA FALLS MACHINE CO., SENECA FALLS, N. Y.

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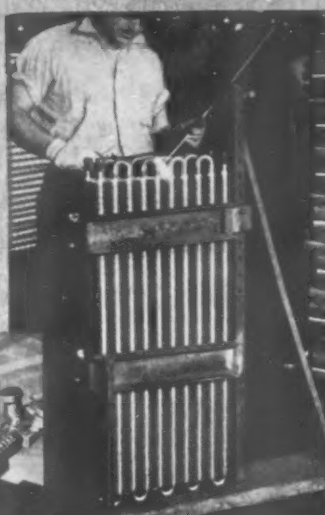

The EASY-FLO and SIL-FOS alloys make torch brazing so easy that unskilled operators — men and women — can give you fast production of top-quality joints after only a few hours training.

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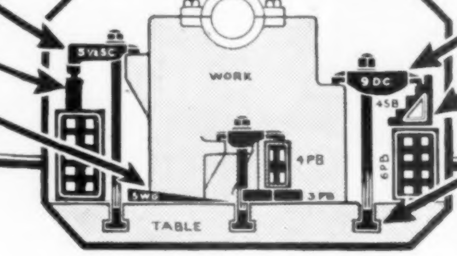

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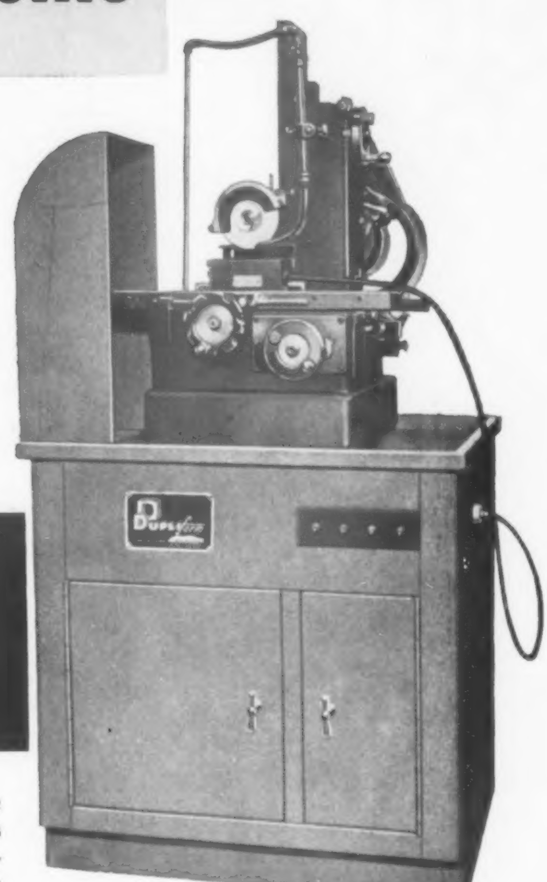

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Typical tolerance: less than .0005" total run-out of spindle 12" from bearing. Bed ways precision ground to within .0005" variation.

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Extra rugged in construction. Self lubricating bronze bearings protect vital wear points.

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You've used regular "mikes" for such a long time you'll be amazed at the downright accuracy and plain honest-to-goodness convenience you can get with this CONSTANT PRESSURE, INDICATING MICROMETER. Just try it and you'll know why so many are buying it!

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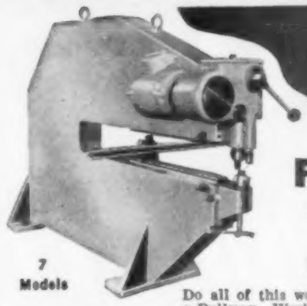

7 Models

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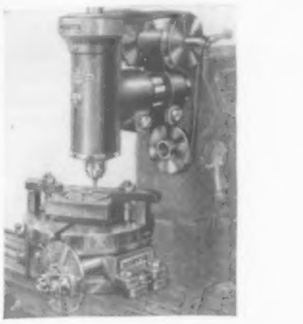
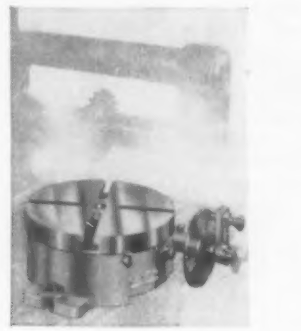
MARVIN rugged designing and precision engineering give you tool attachments of the highest quality at a new low price. See MARVIN MACHINE TOOL ATTACHMENTS in operation at ASTE Industrial Exposition in Philadelphia at Booth 1010.

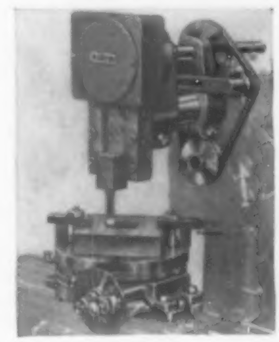


MARVIN VERTICAL MILL ATTACHMENT. No. V-1200, a Head combining simplicity and high performance with low cost. This Marvin **Head can be set at angles,** pulled out far past the travel of the table for large overhanging work. Extremely simple to attach. Has a heavy spindle equipped with Timken tapered roller bearings which assures smooth operation at high speeds. Spindle nose takes end mills with 3/8" straight shank, up to 7/8" diameter cutter. Unit is machined to slip over 1 1/2" overarm. Easily adapted to other size overarms. No extra motor needed — height 7 1/2". Price $65.00.

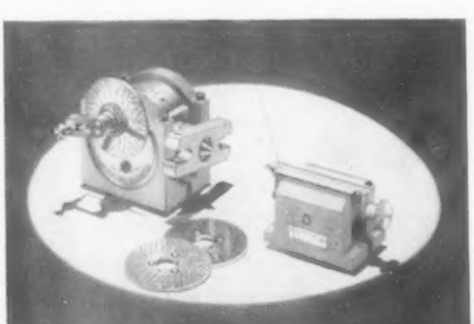


MARVIN ROTARY INDEX TABLE. No. 7-1102. A strong rigid precision table at a moderate price.

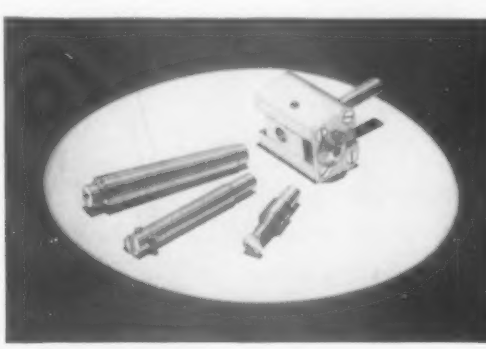
The 6" table is graduated in degrees and has "T" slots for 3/8" bolts, with a bushing in the center. Table locks from the bottom. It cannot tilt. Cast iron worm wheel, hardened and ground worm (40:1 ratio). Worm can be disengaged. 3 index plates with 6 sets of holes each give a wide range of divisions. Hand wheel also furnished, graduated in 1/2 degrees. Height 2 5/8" . . . which gives ample working space. Price $93.00.



MARVIN SLOTTING ATTACHMENT. No. S-1070. The Marvin Slotter can be quickly mounted. **It can be set at angles to get draft on dies,** etc. Can be pulled out past the travel of the table to handle large overhanging work. The stroke is adjustable from 0" to 2". Holder takes tools having 1/2" shank, machined to fit 1 1/2" overarm by using a bushing or turning down a special overarm. Height is 7 1/2", width 4 1/2". Machines dies, squared or splined holes, internal gears, etc. Price $82.00.



MARVIN DIVIDING HEAD. No. D-1400. The Marvin Dividing Head provides wide latitude in selecting various divisions to meet specific requirements. The Marvin Head is ideal for dividing operations required in gear cutting, lay out, splines, fluting taps or reamers, cams, hex screws or squaring shafts. Unit comes complete with 3 index plates, each having 6 sets of holes. It will tilt 5° below horizontal axis to 30° past vertical axis—total 125°—weight 15 lbs. Head is mounted on 2 heavy trunnions. Tail stock has 2 pins—ratio 4:1. Tail center travel 1/2". Vertically adjustable for tapered work, spindle nose No. 2 Morse Taper Socket and 1"-10 threads. Price $99.50.



THE NEW MARVIN MICROMETER MORING HEAD NO. M-1000T. A versatile precision tool of the highest quality, small in size, low in cost. Designed for use on Milling Machines, Drill Presses, Boring Machines or Lathes. SPECIFICATIONS: Cast iron body 2 1/8" x 1 3/4" • Close fitting slide, adjusting screw to snug up slide or lock it • Slide has 3/8" travel • Dial graduates 1/1000" • Hex socket for adjustment. (Comes complete with the following equipment): 1-7/16" x 3" boring bar • 1 solid tool bit • 1 No. 2 Morse taper shank • 1 3/8" straight shank • 3 wrenches. Priced at $18.00.

MARVIN MACHINE PRODUCTS, INC.

SALES OFFICE • 414 FORD BLDG.
DETROIT 26, MICHIGAN

Indicate A-4-249-1

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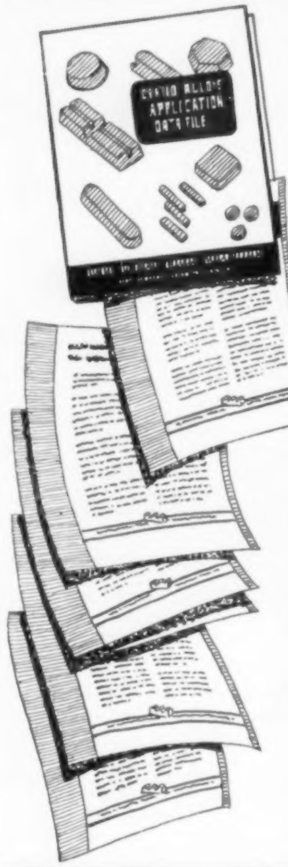

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Famous for THE TIME THEY SAVE!

The Ziegler Tool Holder saves a great deal of time when making set-ups for tapping and reaming jobs because the set-up does not have to be so accurately made, the holder automatically compensating for inaccuracies of as much as 1/32" radius or 1/16" diameter. Try it out and see for yourself!

Even though the work may not be in perfect alignment with the spindle, you can proceed with the job without danger of the holes being bell-mouthed or oversize.

These are the reasons why Ziegler Tool Holders are in such widespread use. Get one for your next tapping or reaming job and see how much better work it will enable you to do.

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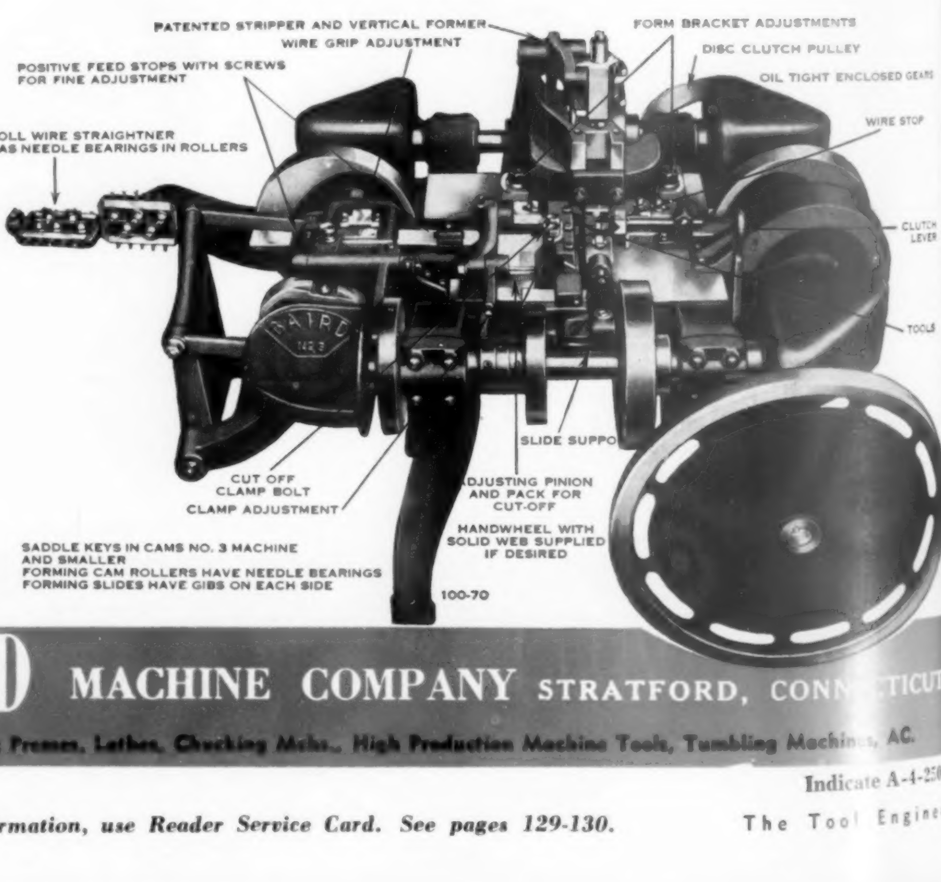
13570 Auburn, DETROIT 23, MICH.

WRITE FOR CATALOG

Ziegler ROLLER DRIVE FLOATING HOLDER *for* Taps *and* Reamers...

Indicate A-4-250-2

WIRE and RIBBON *Metal Forming* MACHINES



7 SIZES

Send samples of your wire and ribbon metal formations to be made in high production at low cost, for estimate.

ASK BAIRD ABOUT IT

THE BAIRD MACHINE COMPANY STRATFORD, CONNECTICUT

Baird also makes Automatic Presses, Lathes, Chucking Machs., High Production Machine Tools, Tumbling Machines, AC.

Indicate A-4-250-3

broaching will really save you money on those close tolerance high speed internal gears

HERE'S AN ACTUAL CASE:

The Old Production Line-Up	The Way It's Handled Now
1. Rough Broach	1. Rough Broach
2. Shape	2. Finish Broach
3. Shave	
Required Tolerance .0002"	Required Tolerance .0002"

EQUIPMENT USED:

1 Broaching Machine	4 Broaching Machines
18 Gear Shapers	
2 Gear Shaving Machines	

These are actual figures from a well known automotive gear plant which adopted the all-broaching procedure about 2 years ago. Since then savings have been spectacular.

Of course they don't use the garden variety of broaches. The savings and precision achieved would not be possible with ordinary tools.

This plant uses NALOY BROACHES each of which is good for 38,000 gears before it is retired. Naloy broaches have characteristics (and we can prove this) that the average broach shop just doesn't have the facilities to duplicate.

If you want Precision with maximum economy, send for a Red Ring Broach Engineer.

See the latest ideas in broaching and other Red Ring equipment in BOOTHS 601 AND 602 at the ASTE "COST CUTTING EXPOSITION" in Philadelphia, April 10-14

NATIONAL BROACH AND MACHINE CO.

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WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

Indicate A-4-251-1

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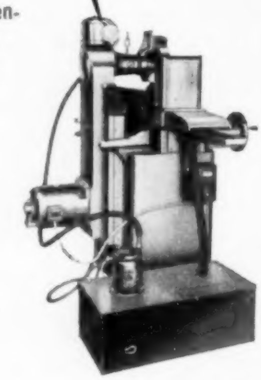
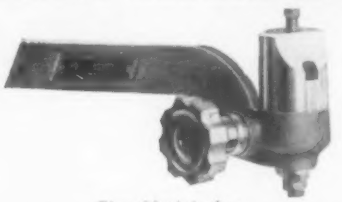
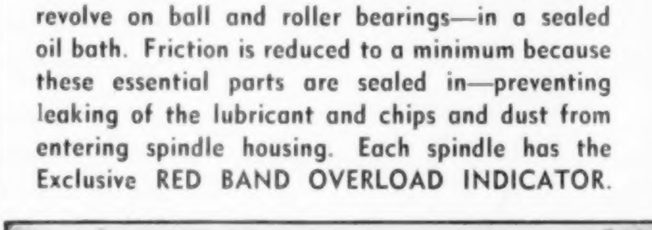


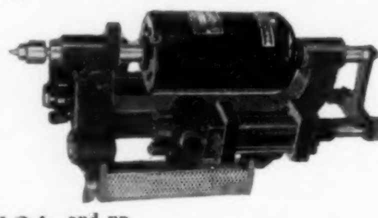




STRAIGHT SHANK TURNING TOOL
RIGHT HAND OFF-SET SIDE TOOL
BORING TOOL
RIGHT HAND OFF-SET CUT-OFF TOOL
LEFT HAND TURNING TOOL
LEFT HAND OFF-SET SIDE TOOL
LEFT HAND OFF-SET CUT-OFF TOOL
THREADING TOOL
RIGHT HAND TURNING TOOL
STRAIGHT SHANK CUT-OFF TOOL

PRECISION DRILLING

MADE EASY WITH THIS COMPACT UNIT .004-.156"



- Fingertip Variable Speed
- 1000 to 15,000 RPM
- Fast Approach Air Feed
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$213.50 and up air feed **$124** and up lever feed

'Speed-Right' CONTROLLED SPEED DRILLING MACHINES

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"BALTIC" SWEDISH VERNIER CALIPERS

1/1000-inch reading to 6 inches

$19.75 LIST

True precision now available for close-tolerance work—gives extreme accuracy in inside, outside, depth and thread measurement. Precision ground and lapped measuring surfaces; engraved, easily legible figures and glass-hard scales; sliding head carries inside and outside jaws and the vernier scales: 1/8" x 5/8" ground bar. Unconditionally guaranteed; names of large plant users on request. Write for circular.

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Importers of fine tools, guns, ammunition

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Every toolroom needs Ray-Metal "Hi-Rockwell" drills. These tools drill precision holes in steels testing C-40 to C-68 Rockwell quickly and without annealing. Ideal for reworking tools and dies, they actually cut a curled chip! *THEY CUT!!!*

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Sensationally Priced!

TRINDL ARC WELDER
Super Industrial Type

Portable	Only
125 Amp.	$69.50
Capacity	F.O.B.

Complete ready to operate

Here is the portable Arc Welder every Tool and Die Maker needs. It welds light and heavy guage metals ... Saves time, labor and money. Ideal for countless tool room jobs ... Handy for fabricating jigs.

This sensationally priced Model 125A Welder is but one of a wide range of models. There's a Trindl Welder for every job and every purse. Order direct or write Dept. T22-DA for free literature.

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Built by the Makers of PRECISION OPTICAL INSTRUMENTS

Mark of fine toolmakers everywhere is the perfection of the instruments they work with. A Bausch & Lomb glass assures you of unsurpassed excellence in design, in material and workmanship.

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B

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- **A.** Loupes .... **$1.05 to $12.00**
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WITH INTERCHANGEABLE CARBIDE TIPPED TOOLS

LOW TOOL COST FEATURED WITH "APEX" TOOL HOLDERS AND BITS

All Standard Shapes carried in stock for machining Steel or Cast Iron.

Manufacturers of Inserted Tooth Milling Cutters, Round Shank or Shankless Tool Holders and Tool Bits.

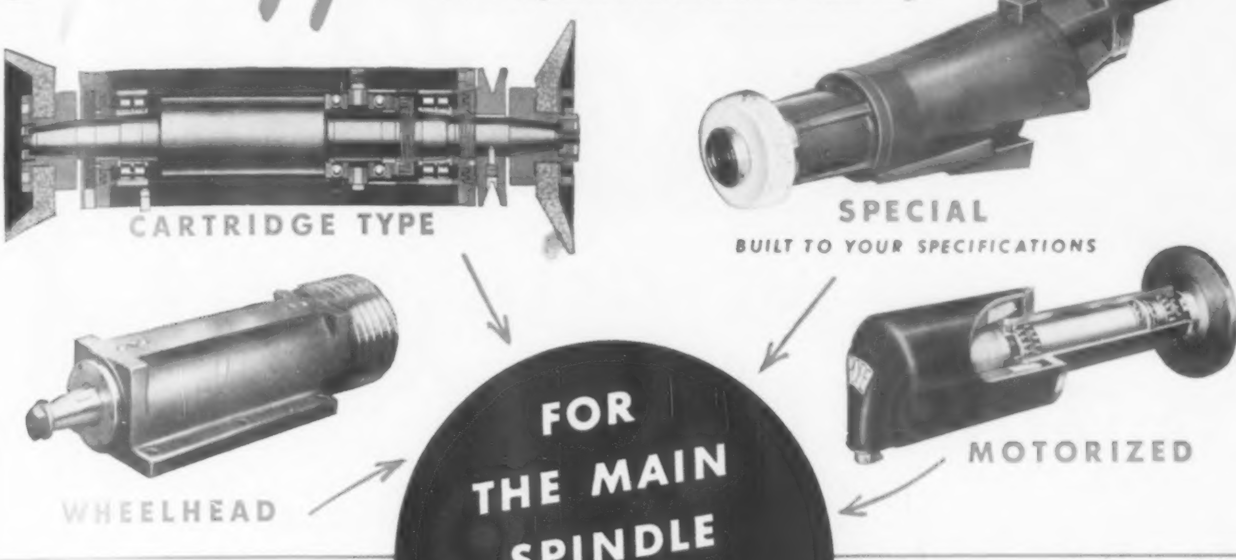
You are invited to inspect these tools, Booth 5, ASTE Industrial Exposition, Philadelphia, Pa., April 10-14th, 1950.

THE APEX TOOL & CUTTER CO., INC.
SHELTON, CONNECTICUT

Indicate A-4-254-6

POPE

Specify: POPE PRECISION SPINDLES with *two* double-row, *super-precision,* cylindrical roller bearings and *two* separate ball thrust bearings



Why:

Because POPE Precision Spindles have more radial and axial rigidity to support the modern, high production cutting tools used for boring, milling, drilling or grinding.

1. POPE Spindles are dependable and trouble-free. *They revolve accurately under the heaviest loads.* This means continuous production of accurate parts.

2. POPE Spindles eliminate chatter. There are no internal clearances between the rotating parts. But there is an internal preload which assures accurate centering of the shaft without depending on the maintenance of an oil film.

3. The indicator readings taken on the noses of thousands of POPE Super-Precision Spindles show less than one half of one ten thousandth (less than 50 millionths) of an inch.

When you want a Precision Spindle, let us have your specifications and you'll receive a prompt reply including price and delivery

No. 68

POPE

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BUILDERS OF PRECISION SPINDLES

Indicate A-4-255-1

Index of Tool Engineer Advertisers

APRIL, 1950

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NEW SCHRADER BANTAM-SIZE AIR CLAMPS

WEIGH LITTLE
COST LITTLE

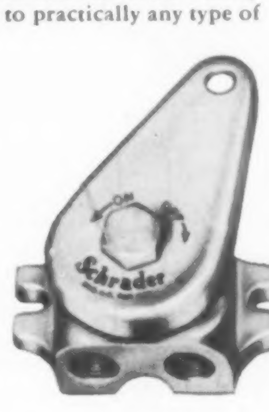
BASE MOUNTED TYPE SHOWN
(Leg Mounted Type also Available)

Do you know what a tremendous saving in time and muscular effort can be made by using Air Clamps for holding work in position to be processed? Air Clamps have obsoleted manual or mechanical devices for holding work. And here are the Air Clamps that make *every* application practical and economical.

The new Schrader bantam-size Air Clamps save space—they pack all the power possible into the least dimensions; Piston and body are ruggedly constructed for long, hard use. Body is of precision-machined cast brass—easily maintained. And Schrader Air Clamps are adaptable to practically any type of application. There are two types of mountings, base or leg; six models in each type—strokes of 1 to 2 inches; cylinder diameters—1", 2¼" and 3".

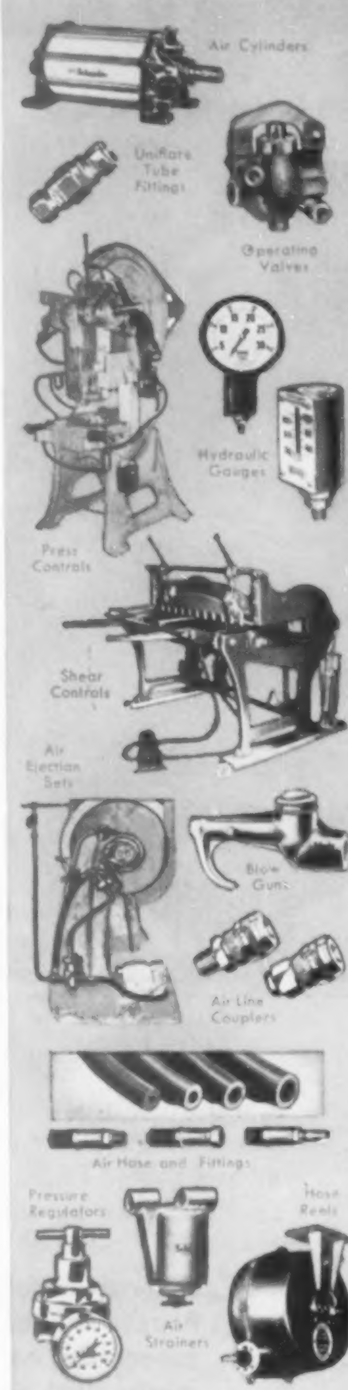
There's a Schrader Air Clamp for every application and they weigh so little and cost so little you need not hesitate to design them into production machines with confidence.

Write for a complete catalog data sheet today.



NEW THREE WAY VALVE This valve is especially designed for use with above cylinders. The valve body houses a precision lapped stainless steel disc which slides on a bronze ring providing positive sealing action—featuring ease of maintenance. Can be operated manually or mechanically.

A few of the thousands of Schrader Air Control Products



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- Press & Shear Controls
- Air Ejection Sets
- Blow Guns
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- Hose Reels
- Hydraulic Gauges
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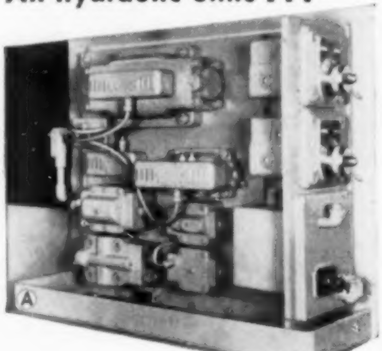
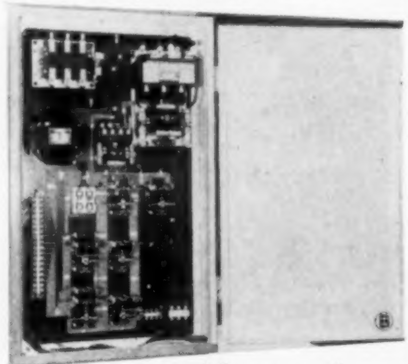
All hydraulic units . . .

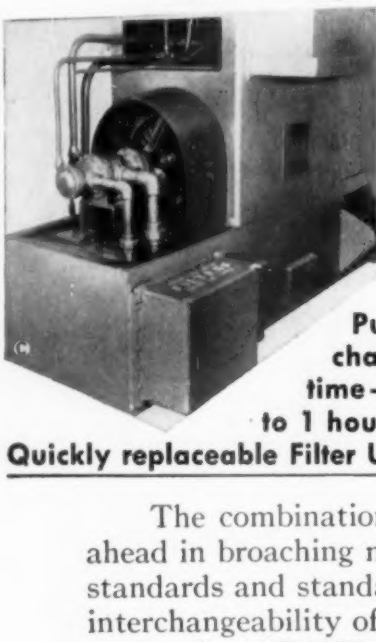


. . . out in the open

Locate any electrical . . .

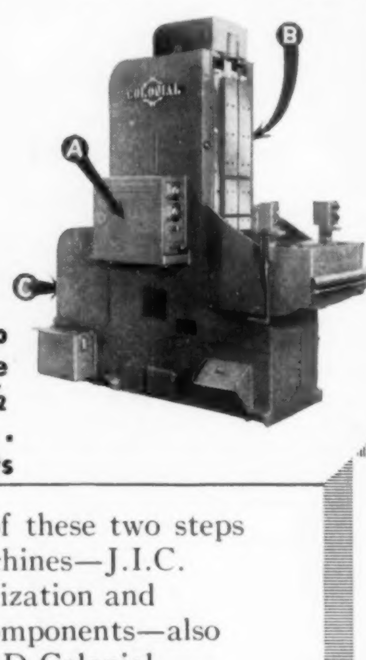


. . . trouble at a glance



Pump change time—½ to 1 hour. . .

Quickly replaceable Filter Units



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Colonial has added interchangeability of components—*hydraulic, mechanical and electrical.*

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